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The Journal

OF THE

AMERICAN DENTAL ASSOCIATION

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Tic Douloureux—*Hardgrove*

Fractures of Maxilla—*Richison*

Temporomandibular Joint—*Higley*

Control of Wax Distortion—*Lasater*

Pathology of Periodontal Pocket—*Kronfeld*

Time Required to Cast Gold—*Myers and Pfeiffer*

Crown and Inlay Casting Technics—*Nelson*

Dental Needs of Children—*Knutson et al.*

Status of Pulpless Teeth—*Simpson*

Treatment of Paradentosis—*Haley*

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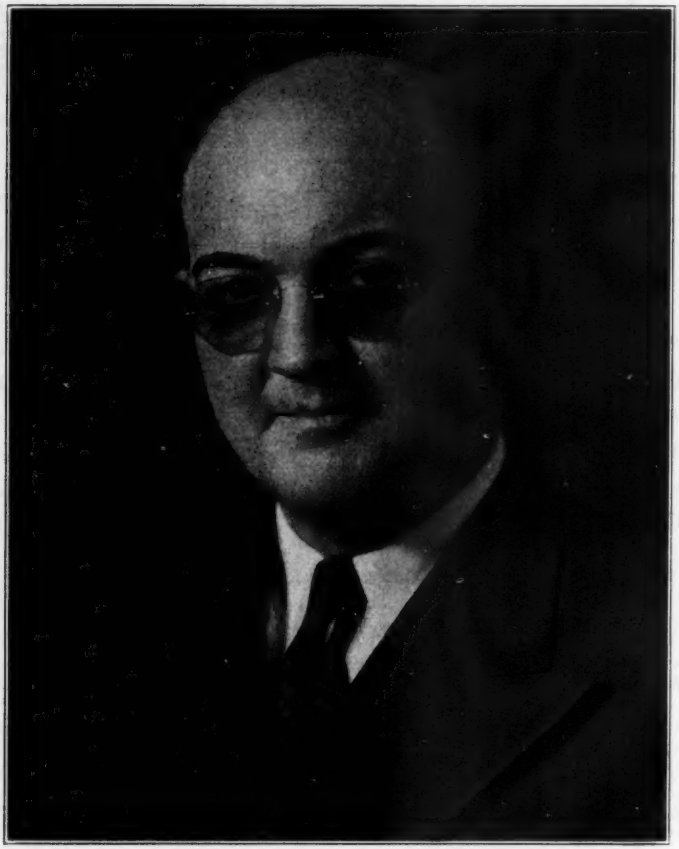

GERALD D. TIMMONS, Ph.G., D.D.S.
Executive Secretary of the American Dental Association

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CLINICAL PATHOLOGY OF THE PERIODONTAL POCKET

By RUDOLF KRONFELD,* M.D., D.D.S., Chicago, Ill.

IN the practice of periodontia, the treatment of periodontal pockets is undoubtedly the main problem. In order to justify this statement, it should be recalled that, regardless of terminology, periodontal diseases can be divided into three fundamental groups: (1) marginal gingivitis, due mainly to local irritation, but occasionally also to other conditions; (2) deep, suppurating pockets, and (3) bone atrophy in its various forms. The treatment of the first group lies largely in the hands of the general practitioner. Every well-trained dentist should be able to keep the mouths of his patients free from gingivitis. The third group, atrophy of the alveolar bone, it is difficult to treat. Significant bone regeneration can be expected only on relatively rare occasions. More often, the best that can be done is to arrest bone atrophy and thus preserve the involved teeth for a varying length of time. This leaves the second group, the deep suppurating pockets, as the main condition treated by the specialist who is devoting much or all of his time to periodontia.

Read before the Section on Periodontia at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 18, 1939.

From the Foundation for Dental Research of the Chicago College of Dental Surgery.

*Deceased.

DEFINITIONS

Normal Gingival Crevice.—Under normal conditions, the gingival tissues are attached to the tooth in such a manner that only a shallow crevice exists between the gingival margin and the tooth surface. Under ideal conditions, there may be no crevice at all between tooth and gingiva. The location of the gingival crevice on the tooth surface depends primarily on the age of the individual. In adolescents and in young adults, the bottom of the crevice is located on the surface of the enamel. Later, it is somewhere near or at the cemento-enamel junction; and, in persons past middle age, it is, as a rule, found on the root surface, so that a portion of the cementum is exposed.

Deepened Gingival Crevice.—Although it will probably never be possible, either clinically or in microscopic specimens, to draw a sharp dividing line be-

tween physiologic and pathologic conditions in the gingival tissues, it is desirable that a distinction be made between gingival crevices several millimeters in depth, but without the clinical and histopathologic manifestations of suppuration, and periodontal pockets that are actually suppurating. The term "deepened gingival crevice" is tentatively suggested, for want of another term, to designate a condition in which a crevice of considerable depth exists, but there is no actual evidence of pathologic changes. Such a deepened crevice may, at least from a clinical point of view, remain healthy throughout life, especially if the individual takes good care of his teeth and practices proper oral hygiene. However, there is always the possibility of an accumulation of calculus, food débris and bacteria in such a deepened crevice, and, finally, transition to a pocket, with suppuration.

instances, the patient is aware of the fact that pus is being discharged from the gingival tissues surrounding one or several teeth. In other mouths, the occurrence of lateral (paradental) abscesses is an indication that purulent exudate is accumulating in deep pockets. Careful examination with an explorer of the kind illustrated in Figure 1 reveals the presence of pockets and gives definite information concerning the depth of the gingival crevices around each tooth. During this exploration, it may, for example, be found that the instrument can be passed beneath the gingival margin to the extent of 6 mm. on the mesial side of a tooth; whereas, on the distal, labial and lingual sides, the crevice is less than 1 mm. deep. In such a case, suppuration is, as a rule, confined to the mesial side of the tooth, and the treatment must be planned accordingly.

The presence of a deep pocket causes

Fig. 1.—Explorer to determine depth of gingival pocket and to detect deposits of calculus on tooth surface. (Orban, THE JOURNAL, August 1939.)

Periodontal (Paradental) Pocket.—The term "chronic suppurative pericementitis" (Black) or "paradental pocket" (Gottlieb) refers to pockets of varying depths, the epithelial lining of which is defective or missing and from which a purulent exudate flows or can be expressed by light pressure. Such pockets may be found anywhere in the mouth. Sometimes, only one is present. More often, several are found in the same patient, and occasionally all of the teeth are involved. Calcific deposits may be present on the tooth surface within the pocket, but the existence of a deep pocket alone is sufficient to maintain suppuration, especially in the lower jaw.

DIAGNOSIS OF PERIODONTAL POCKETS

The clinical diagnosis of periodontal pockets is usually not difficult. In many

a break in the attachment of the periodontal tissues to the tooth surface. If, as in the above-mentioned example, the pocket involves only one surface of the root, this loss of attachment is not great enough to result in loosening of the tooth. If, however, a considerable area of attachment has been lost, the tooth becomes loose. The amount of loosening is best determined by placing the index finger of one hand on the labial and the index finger of the other hand on the lingual side of the tooth and moving the tooth back and forth. The amount of mobility is an indication of the extent of bone destruction.

The roentgenogram is an auxiliary means of diagnosis of periodontal pockets. As there usually is a positive correlation between depth of pocket and loss of bone, the roentgenographically visible

bone contour is a fairly accurate indication of the location and depth of the periodontal pocket. However, it should be strongly emphasized that the roentgenogram does not reveal "pockets," but merely shows the amount of bone present on the mesial and distal surfaces. Neither the actual depth of the pocket nor the bone condition on the labial and lingual sides of the tooth can be recognized from the ordinary dental roentgenogram, and therefore the diagnosis and prognosis of the periodontal pockets should be based, first, upon exploration of pockets, then upon examination of the firmness of the tooth and, finally, upon roentgenographic evidence.

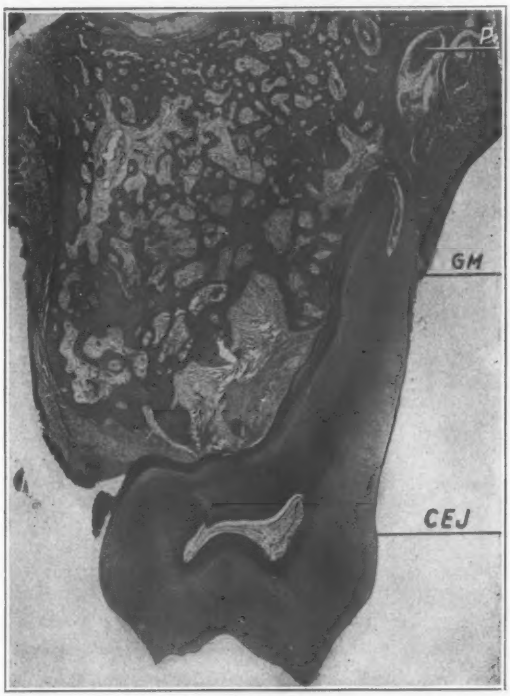

Fig. 2.—Labiolingual section through upper first molar of man aged 51. On the lingual root, there is marked gingival recession without pocket formation, so that about three-fourths of the root is exposed. CEJ, cemento-enamel junction. GM, gingival margin. P, palatine artery.

The amount of purulent discharge varies without definite correlation to the depth of the pocket. In some instances, considerable quantities of thick pus exude from fairly shallow pockets. In others, deep pockets discharge only small quantities of exudate. The condition of the tissue lining the pocket is of greater importance in this respect than the depth of the pocket.

ETIOLOGY OF PERIODONTAL POCKETS

The etiology of periodontal pockets is unknown. The mechanism of their formation is understood, as well as the tissue pathology. We also know how to eliminate pockets by various types of treatment, but it is not known exactly why, in some mouths, the tissues become detached from the tooth surface, thus

forming periodontal pockets. The problem of pocket formation can be divided into two separate questions: 1. Why do the tissues become detached from the root surface at an abnormally high rate of speed? 2. Why do the detached tissues sometimes shrink and sometimes remain unchanged? This division is necessary because accelerated detachment of the soft tissues from the tooth surface does not necessarily cause pocket formation. Every practitioner has seen patients in whom, for instance, the entire lingual surface of the lingual root of an upper molar or the labial surface of a lower incisor root was exposed, yet there was no pocket formation and no gingivitis. The gingival tissues simply recede or shrink at the same rate at which they become detached (Fig. 2). Without this recession, deep pockets would undoubtedly have formed in these areas.

It has become customary to accept several factors in the development of periodontal pockets. Some of these are no doubt contributing factors. None, however, can be used in explanation of all cases, or even in a large percentage of them. Occlusal stress has been cited as a primary etiologic factor in pocket formation. Whether this is so remains to be seen. In animal experiments, it has not been possible to produce deep pockets by lateral stress. In man, pocket formation on the side of pressure of teeth under lateral stress is occasionally ob-

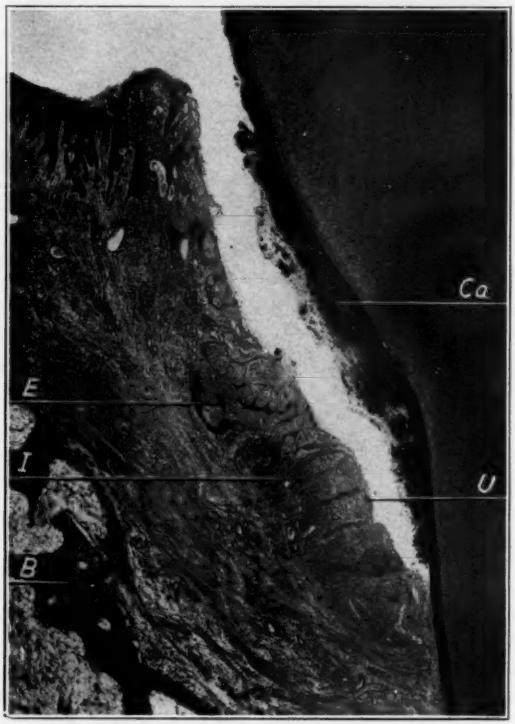

Fig. 3.—Periodontal pocket on mesial side of upper second molar of man aged 50. Ca, calculus on tooth surface. U, ulcerated inner wall of pocket. E, irregular remnants of pocket epithelium. I, infiltrated subepithelial tissue. B, bone.

served; but it is not certain what rôle occlusal stress has played in the etiology of these pockets. Mechanical irritation, such as prolonged irritation from calculus, food packs, the toothpick or dental floss, does occasionally result in pocket formation. Diabetes, vitamin deficiencies and endocrine disturbances sometimes cause the development of periodontal pockets; but the instances in which such etiologic factors can be demonstrated are relatively rare. In the majority of cases of generalized pocket formation, the etiology is unknown.

PATHOLOGY OF PERIODONTAL POCKETS

A periodontal pocket is formed by a flap of gingival tissue that lies loosely against the tooth surface. The outer wall of this flap is covered by gingival epithelium, which is, as a rule, intact. The inner wall has a more or less defective epithelial layer. In the area where the epithelium is missing, the highly inflamed subepithelial connective tissue is exposed within the pocket. From this infiltrated connective tissue, fluid and round cells exude into the pocket and appear as pus. The root sur-

Fig. 4.—Advanced gingivitis and beginning pocket formation between lower second bicuspid and first molar of man aged 50. Ca, calculus on the root surface. U, ulcerated gingival surface. V, hyperemic blood vessels. B, rarefied bone trabeculae of interdental septum.

face inside the pocket is usually covered with hard and soft deposits, unless these deposits have recently been removed by scaling (Fig. 3).

The amount of purulent discharge from a pocket depends largely on the degree of destruction of the epithelial lining. Sometimes, the epithelium is intact even in fairly deep pockets, and the discharge is then minute or absent. Again, the epithelium may be completely destroyed, and the wall of the pocket may consist entirely of granulation tissue, the supporting tissues are eventually destroyed to such an extent that the tooth becomes loose and finally is lost.

The bone in the vicinity of pyorrhea pockets is in a state of low-grade chronic osteitis, with resorption of the bone by osteoclasts and replacement by fibrous connective tissue. This bone is never actually exposed, and there is no necrosis.[1] The individual trabeculae of bone are gradually thinned out by the action of the osteoclasts, until they disappear completely. If the bone underlying

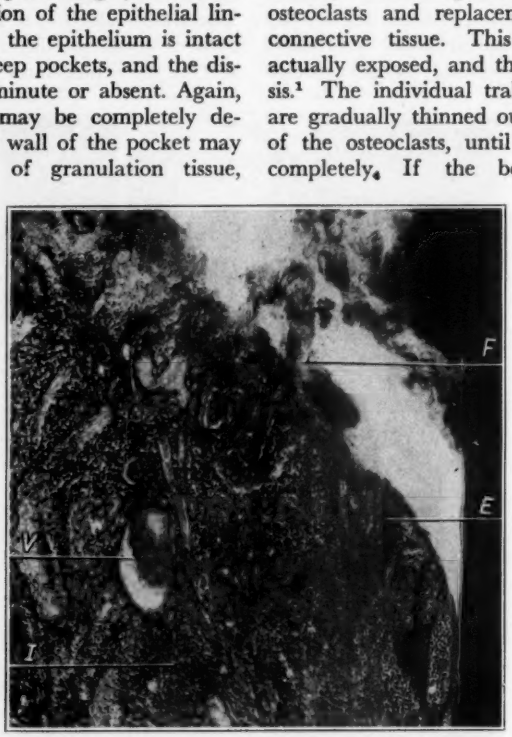

Fig. 5.—Higher magnification of gingival surface in Figure 4. I, dense round-cell infiltration of connective tissue. E, remnants of epithelium. V, hyperemic vessels. F, fibrin clot sealing the vessels on gingival surface.

from the surface of which large quantities of pus are discharged.

Inflammation and suppuration gradually destroy the attachment of the soft tissues to the root surface, the pocket slowly becoming deeper. Thus, a vicious circle develops: the deeper the pocket, the more intensive the inflammation; the increasing inflammation, in turn, favoring further tissue detachment and deepening of the pocket. If a suppurating pocket is permitted to persist for years, pyorrhea pockets were necrotic, it would be exfoliated and cast off, as the small pieces of dead bone sometimes are cast off from a dry socket. The very fact that bone is not exfoliated in pyorrhea is evidence that bone necrosis is not involved. For this reason, any therapeutic procedure for removal of bone around teeth with pyorrhea pockets is, at best, superfluous, and is likely to be harmful, since it may deprive the tooth of some of its valuable remaining bony support.

It must be clearly understood that, in case of suppurating pyorrhea pockets, the bone involvement may be secondary, induced by the superficial inflammation and suppuration. Consequently, the therapy should be mainly directed toward elimination of the pocket and control of the suppuration. Once pocket and pus formation have ceased, bone destruction usually comes to a standstill, and no further treatment is necessary, beyond maintaining ordinary oral hygiene.

BLEEDING GINGIVAE

One of the clinical symptoms frequently associated with advanced gingivitis and with pocket formation is gingival hemorrhage. Sometimes, bleeding is spontaneous. More often, it is elicited by minor insults to the inflamed tissues, such as chewing, the use of the toothpick or dental floss and, particularly, tooth brushing. Through advertising slogans, the public has become familiar with the term "pink tooth brush," which implies that gingival hemorrhages occur when the teeth are brushed. Obviously, the remedy of this condition is not the use of any particular type of dentifrice, but the elimination of the factors in gingivitis and abnormal vulnerability of the gingival tissues.

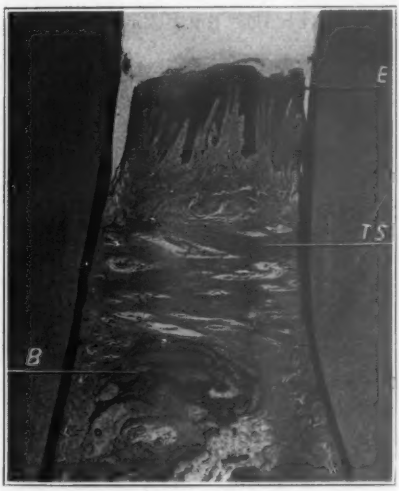

Fig. 6.—Normal interdental tissues between upper first and second bicuspids of man aged 64. E, intact hornified epithelial surface. TS, transseptal fibers. B, alveolar bone.

The normal intact gingival mucosa has a hornified surface which acts as a protection and which is resistant enough to withstand vigorous tooth brushing without permitting blood to escape from the subepithelial connective tissue.[2] Under pathologic conditions, especially in the presence of calculus, the epithelial covering of the gingivae may be almost entirely absent. The gingival tissues are hyperemic, the blood vessels are engorged and the tissue surface is covered by a delicate film of coagulated fibrin and desquamated cells (Fig. 4). Any mechanical irritation, such as tooth brushing, may dislodge the plug of fibrin which seals the blood vessels, and a hemorrhage occurs, persisting until a new coagulum has formed over the end of the injured blood vessel (Fig. 5).

If the source of irritation is removed and the patient is instructed in proper care and brushing of the teeth, the epithelium, as a rule, regenerates rapidly, covering the gingival surface and protecting the delicate blood vessels of the subepithelial tissues. At the same time, the hyperemia and infiltration subside, and normal conditions are finally reestablished (Fig. 6).

THERAPY OF PERIODONTAL POCKETS

There are two main schools of thought concerning the therapy of periodontal pockets. One group of clinicians considers the elimination of the wall of the pocket as the method of choice. This goal is achieved by surgical excision, electrocoagulation, packing or cauterization with chemicals, or a combination of several of these methods. The ultimate result is the same for all these methods: removal of the entire flap of tissue that

forms the pocket, thereby exposing the area of root surface formerly located within the pocket. Another group of clinicians believe that a reattachment of the gingival tissues to the root surface is possible, and they treat the pockets for the purpose of bringing about reattachment.

It is difficult to evaluate comparatively these two main methods of treatment. The effectiveness and satisfactory results of the treatment based upon the removal of the loose tissue flap are well known and generally recognized. The claims of those favoring reattachment therapy are based largely upon favorable clinical observations by a few, though outstanding, practitioners, and upon the microscopic findings in a few specimens of teeth treated by this method. I feel that the advocates of the reattachment therapy should furnish more extensive, more carefully controlled and more objective proof for their claims. How this can be done has been shown, among others, by Zemsky,[3] Mann, Crane and Kaplan[4] and Lundquist,[5] who used a satisfactory technic of microscopic verification of clinical results in human beings.

PROGNOSIS FOR PYORRHEA PATIENTS

There has been a tendency among dentists, and especially among laymen connected with the manufacture and sale of dental products and instruments, to overstress the possibility of a permanent cure of pyorrhea. Words like "eradication" are, in my opinion, entirely out of place. Pyorrhea, if we understand it to be primarily characterized by pocket formation and loss of bony support, is an extremely chronic and protracted condition, with a definite tendency to progress and little possibility of restitution and repair. The best we can hope for in most cases is to maintain the teeth in a useful state of function and health and to prolong their span of usefulness. We cannot "eradicate" anything, because, first of all, we can rarely restore the lost tissue attachment and, secondly, we cannot know to what extent we have arrested or even retarded the pathologic process by treatment.

Most intelligent patients give a story of a gradually progressive process of pocket formation and loss of bone, or even teeth, extending over a considerable period of years. If, at this stage, proper treatment is instituted, such as scaling, gingivectomy, balancing the occlusion and restoration of missing teeth, the patient may be dismissed in the best possible condition for the time being. A few years later, however, the same or a similar treatment may be indicated, not because the first treatment was ineffective, but because the disease was gradually progressing.

The situation resembles somewhat the condition often prevalent in the practice of ophthalmology. The refraction is determined and glasses are prescribed to correct the existing anomaly of vision. But has this anomaly been "eradicated"? Not at all. In all probability, the patient will have to return in a few years and have new glasses made, because the pathologic process in the eye, whatever it may be, is progressive. Thus, a desirable and mutually beneficial relationship develops between ophthalmologist and patient: the former assumes the responsibility of safeguarding the patient's vision by continued supervision and, if necessary, changes in and repetition of treatment. The patient, on the other hand, realizes that he is not "cured," but that the doctor has restored the optimum function possible at the given time and may have to modify his procedure if the condition of the eyes changes.

A similar relationship should, I believe, be established between patient and dentist. The patient should be given to understand clearly that, in taking charge of him, the dentist cannot work a miracle and undo all the damage that has been done, nor can he promise to arrest the pathologic process affecting teeth and

jaw. What the dentist can do is to prolong the period of usefulness of the teeth. Teeth that without treatment would probably be lost in a few years can be saved for several decades, and the need for extensive restorations can be postponed accordingly.

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122 South Michigan Avenue.

TIC DOULOUREUX: ETIOLOGY, ACCURATE DIAGNOSIS AND TREATMENT BY THE USE OF TYPHOID VACCINE

By T. A. Hardgrove, D.D.S., Fond du Lac, Wis.

THE second report on the treatment of tic douloureux by the use of typhoid vaccine is presented with positive evidence. This method of treating tic douloureux has now been used by a number of medical men, but by only a few of the dental profession as yet. The treatment should be administered by the dental profession as well as the medical profession for the reason that it was developed by dentistry and the symptoms are within the field allotted to the dental practitioner, the relief of pain in the oral cavity and adjacent tissues.

It is my belief that tic douloureux is but an aftermath of a previous typhoid invasion or infection. Truman W. Brophy states that it is due to an irritation of some sort and assigns to it a variety of causes. He says, "Trifacial neuralgia may follow in the course of malaria, influenza, syphilis, rheumatism, diphtheria, typhoid fever or any disease of an infectious nature as a result of the toxins, and it may be the sequel of poisoning from chemicals, as arsenic, copper, lead, phosphorus, etc." A number of people having tic douloureux give a history of typhoid. Hugh T. Patrick says, "That there is no direct and similar heredity in facial neuralgia seems quite clear. Though in seven of my cases there was a history of this disease in descendants or other relatives, in no case was a parent affected."

A peculiar thing about tic douloureux is that it usually begins in adult life. Seldom do we see the condition in children, and seldom do we see typhoid fever in children. That too can be looked upon as an adult disease. You will note that, according to Dr. Brophy, there was a possibility of tic douloureux following some one of the infectious diseases. He states, however, that the presence of

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impacted teeth, diseased antrums and exposed pulps and irritations of that nature are the cause of the disease. The fact that, according to Dr. Patrick, there is a tendency to tic douloureux in the families or descendants of the afflicted can be explained by the fact that families many times are apt to have similar diseases, and the condition is due many times to their sanitary habits or to infection from a common source. If sanitation were carried to the point where typhoid fever would be eliminated, there would be no tic douloureux. The evidence presented tends to support the theory of infection by typhoid of the tissues in which pain is experienced.

Thus far, we have been unable to find typhoid organisms in nervous tissue of the trifacial nerve. One reason for this is that we cannot obtain the tissue for examination. Clinical histories and the treatment and relief of disease by means of typhoid vaccine point toward a typhoid infection.

In the previous report, it was recommended that the following procedure be carefully carried out. First, there must be a positive diagnosis. We know of no other form of neuralgia that typhoid vaccine will cure. The diagnosis should include a complete history, with determination of the trigger zone, the tender points (Valleix's) and the areas of spasm. There should be absence of pain at night and onset of pain when the tender points are touched as in shaving, eating and washing the face. The teeth can be discounted as a factor in the disease. That the infection is of a systemic character explains why the teeth are not a factor. Many peculiar symptoms arise during the onset of the condition that finally becomes a true tic douloureux. By that, I mean that pain of an obscure nature, not yet severe enough or constant enough to be of great annoyance to the patient, but still positive, frequent and characteristic enough to indicate a beginning trigger zone or tender point, and spasmodic pains are developing. I call attention to this condition so that it can be recognized early, when only a small amount of typhoid vaccine may have to be used to overcome the pain.

This disease, like many others, if treated early, responds more quickly to treatment. One must realize also that there are cases of neuralgia that are not tic douloureux and never will be. It is safe to call tic douloureux the major neuralgia of the head and face. According to Brophy's classification, there is a secondary neuralgia, in which the nerves themselves are diseased or tumors are formed along the course of the fifth or trifacial nerve. He names also a neuralgia minor, which can be referred to as a burning type of pain and which does not become a true tic douloureux.

I wish to refer in particular to this burning type of pain, which we have seen for some time, more pronounced in the last ten years or before, and not quite so common in the last three years. These cases too were probably of some abnormal physiologic or remote pathologic origin rather than of a local character. At any rate, the symptoms of a major or true tic douloureux are so pronounced that there would be no confusion in the diagnosis.

After the diagnosis is made, the treatment of a chronic type of tic douloureux must be more persistent and heroic than in the milder or beginning cases. I present here the dosage of a case treated by S. E. Gavin, of Fond du Lac, Wis., which indicates, to a large extent, how a typical, well-established, chronic tic douloureux should be treated.

October 27, 1938—50,000,000 organisms (0.05 cc.)
October 31—100,000,000
November 5—200,000,000
November 9—400,000,000
November 13—400,000,000
November 17—500,000,000
(Noted improvement)
November 21—500,000,000

November 25—500,000,000
November 29—500,000,000
December 3—500,000,000
December 8—500,000,000
December 13—600,000,000
(Tic and pain both disappear)
December 17—600,000,000
December 23—600,000,000

It will be noted that the pain began to subside when the sixth dose had been given and a dose of 500,000,000 organisms (0.5 cc.) had been administered intravenously. The pain and tic disappeared entirely at the twelfth dose. In this case, the dose was never carried higher than 600,000,000. It is my belief that it is not necessary to go above 500,000,000, although the dentist or physician treating these cases must, I believe, be guided by the reactions and symptoms shown by the patient. This case was treated and the patient allowed to be up and at work with the exception of the afternoon of the administration of the vaccine and the day following. It was usually administered on Saturday and the patient was able to work on Monday. In the preliminary examination, each time the temperature was taken, it was found to be normal. This patient complained of neuralgia to her physician March 5, 1938. She was not seen by him again until June 28, and was not under observation again until September 21. There was no rise in temperature or pulse rate and no vaccine was used up to that time. The first dose, 50,000,000 organisms, was given October 27. As the chart shows, the dose was gradually increased to 600,000,000. In this case, fourteen intravenous injections resulted in a cure.

It is well, I believe, to caution patients as to their sanitary habits, to protect them from typhoid invasion. Water may be a source. This does not mean that a patient must have run a true course of typhoid fever. Tic douloureux and other disturbances may be present without a clinical history of typhoid.

Dr. Brophy stated many years ago that the typhoid organism is a frequent inhabitant of the parotid gland. If this is true, probably it is an inhabitant of other salivary glands, but its presence is not apparent because the nerve tissue does not pass through the gland substance. In some of these tic douloureux patients, the face is twisted, and the patient presses the face in the region of the parotid gland until there is some degree of relief. Since the facial nerve passes through the parotid gland, it is not unreasonable to believe that this gland is irritated by the presence of bacteria, and that, in trifacial neuralgia, there may be a disturbance of the facial nerve.

The fact should be emphasized that the beneficial results are not the reaction to a foreign protein, nor is relief due to the possible temperature rise from injection of the vaccine, since the pain will disappear just as quickly if no rise in temperature occurs. We use the unmixed pure strain of typhoid vaccine in the belief that we are dealing with a typhoid infection, and relief of the symptoms points toward immunization as the means by which a cure is established. Whether, in these cases, the typhoid organism remains in Peyer's patches or in the gallbladder without the patient's being sick from typhoid cannot be positively stated. If typhoid is responsible for tic douloureux, it may be difficult to understand why more people do not have tic douloureux, but it is just as difficult to understand why more people do not have tuberculosis, cancer or other diseases. Not everybody who harbors typhoid organisms has tic douloureux. The average patient will manufacture his own vaccine. It is in only the exceptional case that, through failure of the patient to develop resistance, tic douloureux may develop.

That the treatment of these cases is the all important thing was discovered from a series of clinical observations and experiments. The method of treatment outlined takes from surgery and gives to

medicine and dentistry the possibility of treating this condition.

One thing must be definitely understood: these patients cannot be immunized with one series of typhoid injections. It is necessary to give three or four series over a period of a year or a little longer and three or four months apart for complete immunization.

In some of the cases treated, a record was made of the blood pressure, which was not disturbed. It is, I think, seldom disturbed in tic douloureux, although the patient appears to have high blood pressure during the paroxysm.

We have found not a single case in which the patient did not obtain relief, provided the diagnosis was correct and the technic was followed.

A number of physicians are successfully treating tic douloureux by the use of typhoid vaccine. Not all of the records have been obtained as yet, but it is sufficient to say that S. E. Gavin, of Fond du Lac, Wis., has treated four cases, and A. A. Skemp, of La Crosse, three cases, one case in the father of Dr. Bull, director of dental education in the State of Wisconsin, all with positive and definite relief. A case treated by A. T. Smedal, of Stoughton, Wis., is similar to my first experience in injecting typhoid vaccine. The patient experienced relief from pain after a certain number of injections, but the jerk, or tic, remained until more vaccine had been given. Another was the case of W. D. Stovall, of Madison, Wis., who himself had tic douloureux and resorted successfully to the use of typhoid vaccine for relief.

It is not wise to wait until the pain returns before typhoid vaccine is used again, since immunization can be carried out in the absence of pain. In three or four months, in cases like these, typhoid vaccine should be reinjected to further establish immunization.

While the treatment is quite new, we have now reported a total of eleven cases, without a single failure.

CONCLUSIONS

Tic douloureux is but an aftermath of typhoid invasion or infection.

Relief is obtained by the administration of typhoid vaccine, through the process of immunization, and is not the effect of a foreign protein.

The vaccine can be used intramuscularly as well as intravenously, though the intravenous route is the most effective and quickest. The dose given intramuscularly should be larger than when injected intravenously.

Different patients require different dosage and number of doses.

The first thing to disappear is the pain and next the tic, or jerk.

A study of the patient's reaction will indicate the size of the second dose.

Patients need to be immunized over a period of a year or fifteen months.

The cause never lies in the teeth, and the fact that typhoid is a systemic invasion or infection explains why this is true.

In the process of treatment, the character of the pain is changed.

Usually, tic douloureux does not cause pain at night, but, after the administration of vaccine, the pain may be intensified and may occur at any time, but will not continue for a long period.

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TREATMENT OF PARADENTOSIS AND HYPERTROPHIC GINGIVITIS BY THE USE OF ACETONE

By PHILIP S. HALEY, Ph.D., D.D.S., San Francisco, Calif.

THE following outline of procedure, with comment, is intended to embody my latest experience in the treatment of paradentosis, with the help of the materia medica alone, and in an effective manner. It is based upon the principle of the destructive action of acetone upon living tissue under confinement, this principle being extended to the action of phenol on the tissues as a coagulant of living protoplasm, and of sodium hydroxide as a direct solvent of such tissue.

Although an increasing number of dentists are today using drug therapy in the treatment of paradentosis, certain writers on the subject treat medication as an entirely subordinate agency to surgical measures, the use of the electrocautery, subgingival curettage or planing. This attitude is unjust to the traditional materia medica and betrays insufficient understanding of the utility of it when an effective technic and experience have been acquired. Some writers have rejected drugs as worthless; others have used them in too light a concentration, and still others have recommended their use as accessories to one or the other above-mentioned treatments in such a degree that they might as well have treated with drugs only. These remarks are made only to justify the use of drugs; not as a criticism of any of the foregoing methods. I praise the achievements of my professional brethren and freely acknowledge the value of the several methods of treatment mentioned.

TECHNIC

Unit A contains pink thermoplastic baseplate material, 4 gm.; calamine (pink), 0.35 gm.; acetone, 20 cc., and cotton twills and balls of suitable size.

Unit B contains pink thermoplastic baseplate material softened to the consistency of unvulcanized rubber by the addition of acetone, q. s.

When the cotton balls and twills in Unit A are thoroughly saturated by immersion in the mixture for several hours, Unit A is ready for use. A twill or ball of a size suitable to the pocket to be packed is selected and removed with cotton pliers. It is waved in the air for fifteen seconds to allow a film to form on the surface. With the wet finger tips of the operator, freshly immersed in water, the mass is gently rolled into a cylinder and inserted partly in the pocket with very light pressure. It is then gently packed with suitable packers (Fig. 7) or with a long blunt explorer point, to the bottom of the pocket and into the embrasures. Gentleness is here emphasized in order that as much acetone and thermoplastic may be conserved as possible. The excess remaining in the embrasures, buccally and lingually, is then pressed with a water-moistened cotton pledget in such a way as to seal the embrasures against the tooth surface on each side.

When two or more embrasures are thus

filled, a suitable-size piece of Unit B is cut with scissors or scalpel and shaped into a ribbon of such length and width as will join the embrasures already packed. This strip is allowed to overlap the gum 3 or 4 mm. in order to complete the sealing effect. (Fig. 2.) The fingers are at all times kept moistened with water, and the tongue of the patient is kept from dislodging the mass until hardening has begun.

Acetone, or dimethyl-ketone, possessing the structural formula $CH_3.CO.CH_3$, is an excellent solvent for the pink plate bases of the thermoplastic type. Being inflammable, it must be handled without flame contact of any sort, including electric sparks. Being clear and colorless, it does not tint the packs in which it is used. Another valuable property of the drug is its high volatility, which causes quick drying of the pack after placement. A film of partly dried thermoplastic rapidly forms over the outer surface of the packs, making it possible to mold or squeeze them well into and beyond the embrasures. This surface will unite with the strip pack from Unit B when its surface or that of the inner side of Unit B is well coated until soft with either pure acetone or some of the more liquid material from Unit A. In this manner, a united pack (Fig. 2) is made of the two, serving to confine the acetone, that it may act directly upon the tissues. Strips of "dry-foil" may be used to cover the packs both buccally and lingually, carrying them over the teeth. Pressed well against the gums and teeth, it helps both in maintaining the packs *in situ* and in confining the acetone.

During this process of packing, the patient is instructed to breathe *in* through the nostrils, and *out* through the mouth, so that as little acetone as possible is inhaled. He is also told to blow his breath against his cheeks every few inhalations during the first ten minutes to prevent the slight burning sensation of the membranes of the mouth vestibule and buccal tissues that is otherwise present.

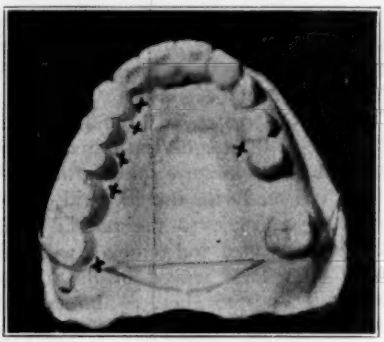

Fig. 1.—Case prior to treatment, showing some of pocket locations (crosses). (Compare Fig. 3.)

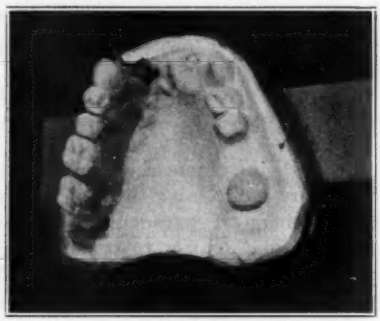

Fig. 2.—Upper right side of case packed palatally.

The patient is asked to return in three days, and the packs are removed. The pockets are then packed with phenol, colored blue with Berwick's solution or bismuth violet. These packs are to be removed in either twenty-four or forty-eight hours, as convenient. If they are annoying to the sensitive patient, he can remove them himself.

At the sitting on the third day, the process may be repeated. After about three of these acetone-thermoplastic-phenol treatments, the pocket tissue will

be found largely destroyed, if the procedure is carefully carried out. (Fig. 3.) Slight remaining areas may be packed with phenol until tissue regeneration has progressed to that point where the case can be dismissed, except for a monthly return for examination, scaling, if not previously completed, and any details in treatment that the operator may wish to carry out, such as occlusal correction, etc.

EFFECTS OF ACETONE AND PHENOL

Acetone does not appear to coagulate the tissues as phenol does. It acts on them only when confined, as far as its local application is concerned, and as far as clinical observation alone enables one to judge. When the packs are removed, the detached wall tissue, or hypertrophied gingival interdental tissue in hypertrophic gingivitis, will be found to have disappeared in whole or in part. A clean, comfortable red field will be found in the place of abnormal tissue, and which rapidly becomes covered with healthy epithelium.

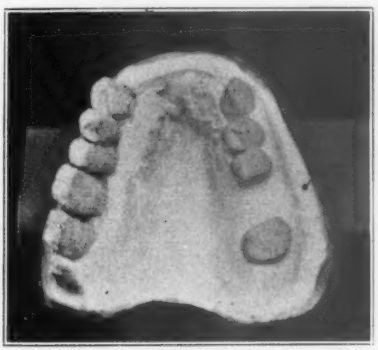

Fig. 3.—Pocket walls destroyed by acetone-phenol packs (three of each). There is granulating pocket tissue in the embrasures.

The teeth are apparently not affected. I have observed no ill effects on the pulp or peridental membrane. Instead of irritation, there seems to be local sedation, with no surrounding field of hyperemia.

Systemically, my clinical results are not evident. Probably, it is best to pack only one arch at any one sitting, since inhalation of acetone may cause a slight dizziness. I observed this in one case, in which I had used a large quantity of acetone-thermoplastic mixture for extending the phalanges of a lower denture. The effect passed off quickly, however, and I have never observed it in packing subgingivally as described.

While acetone removes the pocket contents, probably by diffusion of the confined gas into the cell contents, it does not seal the avenues of metastatic transmission so well as does phenol. The latter closes the small lymph and blood channels, besides coagulating and destroying pathogenic pocket bacteria and fluids. It is for this reason that I have advised its use with acetone. It is also a pulp and membrane sedative, and, together with acetone, continues the destruction of the pocket wall tissue. Between acetone treatments, it maintains the hygiene of the pocket, and the cotton packs maintain dilation of the pocket,

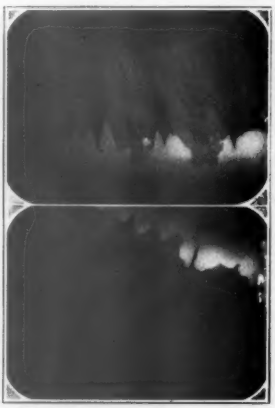

Fig. 4.—Upper and lower right molar regions in man aged 50 years; showing advanced paradentosis and destruction of bone. Compare Figure 6, after nine phenol treatments had been given, and ten months had elapsed.

so desirable for drainage and to assist in regeneration through granulation.

SODIUM HYDROXIDE: EFFECT AND TECHNIC OF USE

Sodium hydroxide, a very useful alkaline agent, can be used for rapid destruction of the walls, being applied prior to either acetone or phenol. It is hardly necessary, however, since it is probably not to be desired that wall destruction be completed in less than several sittings, because granulation sets in quickly and is assisted by the presence of the remaining portion of the wall. The end-effect, as far as I can judge after using all of these agencies a great many times, is the conservation of somewhat more tissue than would otherwise be effected. It rapidly turns the tissue brown, changing it to a jelly-like mass, which liquefies and disappears, even during the act of application.

The drug is best used by rubbing over the outside of the pocket with a cotton-wrapped stiff wire probe, with a pistol grip. The latter assists in field control of application. An aqueous 100 per cent solution is now used, although a good effect may be secured by weaker solutions, from 20 per cent upward. Those beginning its use are cautioned to handle it carefully, to prevent it from coming in contact with lips or tongue.

A cotton roll may be saturated with a 1 per cent hydrochloric acid solution and held tightly against the field to be operated on, just below the line marking the deepest part of the pocket, to neutralize the sodium hydroxide should it escape. A syringe filled with the same acid solution is kept handy and the field lightly sprayed as each pocket wall is cauterized. The base of the tongue is frequently swabbed with the acid solution, and the roll is removed from time to time to allow free syringing with the acid solution.

Occasionally, a local application of any surface anesthetic is useful, to allay the burning sensation that accompanies the use of sodium hydroxide. If any considerable field, such as two or more pockets, is treated, the above described acetone-thermoplastic pack will act as a tissue-protecting splint. This becomes

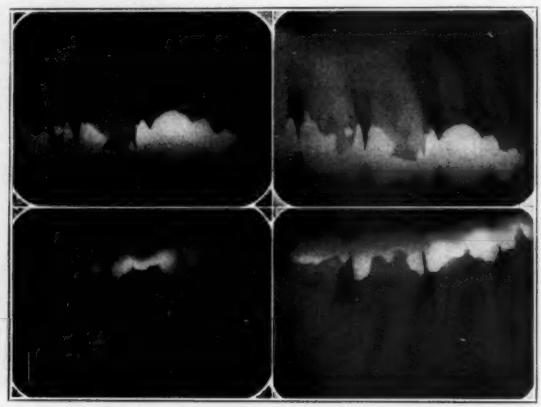

Fig. 5.—Right side showing further regeneration in October 1935, in spite of inveterate smoking and poor home care by patient. Left side presenting another view of the Figure 4 area, for comparison with October 1935 roentgenogram.

hard quickly and may be retained for several days. It has the color of the gums.

TECHNIC FOR USE OF PHENOL

While methods for the systematic use of phenol have been described by me[1] in previous articles and by others[2-5] as well, I shall here give my procedure in making use of the drug today.

A tray having two compartments, supported by a handle in the center, is supplied with a sufficient number of cotton twills and balls for the packing. In the one compartment, dry packs of

Fig. 6.—Lower molar area; same case treated with phenol. There is interdental bone regeneration. (Compare condition in 1935.)

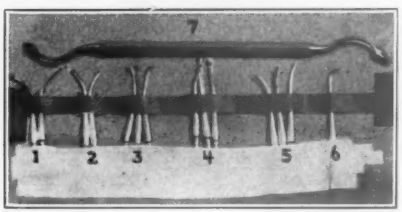

Fig. 7.—Instruments convenient for use in method of treatment described.

this kind are placed. These are of various sizes, a few of them being the size of small marbles, for the application of ethyl alcohol to the palate, posterior portion of the tongue or elsewhere. These large balls are also inserted loosely between the teeth just posterior to the pocket being packed on the palatal surfaces to prevent the phenol from running over the palate posteriorly toward the throat.

In the other compartment are placed twills and balls moistened with the blue phenol described above. The saliva ejector may be placed in position, and a cotton roll moistened with 5 per cent ethyl alcohol in water inserted in the space between gums and cheeks. A pad of bibulous paper is kept near so that the excess phenol may be squeezed from the packs. With a right or left packer, a suitable-size twill or ball is now inserted in the pocket, after being carried to place in the embrasure with the cotton pliers. This packing is carried to the full depth of the pocket with slow, gentle pressure (not a stabbing motion) and worked into the pocket also toward the lingual or buccal and labial walls. A dry roll is now used to take up the excess, with application of pressure. When such packing as is required for a quadrant of the arch is completed, the roll and ejector are removed, the mouth is

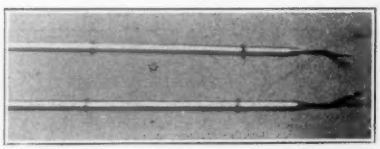

Fig. 8.—Another view of packers.

well syringed with water and the patient is allowed to gargle water. This procedure is repeated for the next quadrant. In general, if there are many deep pockets, it is best to pack only two quadrants at any given sitting. Finally, the mouth is superficially swabbed with alcohol and the patient is dismissed, with instructions to return the next day for pack removal if the packs bother him, which as a rule they do not do. Nervous patients may be allowed to remove all or a part of the packs at bedtime after the first sitting. Thereafter, they should be encouraged to retain the packs as suggested above, for from twenty-four hours to two days.

Under this treatment, symptoms quickly subside. Formation of pus ceases, walls

disappear, soreness under mastication pressure is eliminated, systemic manifestations of different sorts cease, very frequently, and a clean regenerated appearance returns to the tissues. (Fig. 3.) In time, when treatment is carried out with phenol alone, or in conjunction with the other drugs mentioned, excellent healing results. This, as with other methods, however, depends in part on the operator, his patience, experience and skill all being requisitioned. Tissue rebuilding, if the patient cooperates, is often remarkable.

ADVANTAGES

Treatment with drugs requires no anesthesia. There is practically no discomfort. Absence of the fear of the needle or the knife is an advantage.

No apparatus need be purchased. There is no danger of transference of bacteria or toxins to the blood or lymph, because

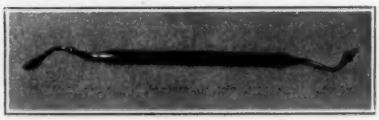

Fig. 9.—Slough remover, to be used for removing gum tissue after packing with phenol.

of destruction within the pocket of infective agents, and the sealing of avenues of entrance for these organisms. There is no pulpitis or pericementitis. There is no local swelling. There is maximum conservation of tissue. There is no needless removal of cementum, since scaling is done in a dilated pocket. There is no tissue laceration. A smooth line or marginal rebuilding eventually takes place. The use of curets, for the removal of fibrosed tissue, is not required. While the matter of reattachment will be in question until we have more histologic knowledge than at present, roentgenographic (Fig. 6) and clinical findings indicate at least as good results for the therapy above outlined as for any other method.

Fish,[6] Orban[7] and others are of the opinion that the bone surrounding the pocketed tissue in paradentosis is free of infection, owing to the efficiency of the body defenses in such fields. This being true, it would seem reasonable to thoroughly cauterize the pocket interiors in all cases before proceeding with treatment by any mechanical agency calculated to interfere with this defense line. Phenol immediately coagulates both cells and albuminoid extracellular fluids.

ROOT TREATMENT

The main point in root surface care is cleansing. This falls under two chief

Fig. 10.—Brush for interdental pocket cleansing. This brush, which is more effective than a rubber point, consists of a porte polisher in a toothbrush handle.

and one secondary operation. First, the crowns of the teeth are polished to the cemento-enamel junction, or even farther when the roots are exposed sufficiently. This may be accomplished with any suitable brush in the handpiece, with pumice or silicon dioxide mixed with vaseline or water for abrasive effect. Supplementary to this, nitric acid with phloroglucin (trihydroxybenzene) may be used. This mixture is made by dissolving 1 gm. of phloroglucin in 10 gm. C. P. nitric acid in a fume cupboard. When the reaction

is complete, 10 per cent nitric acid is added to 100 cc. and applied to the crowns of the teeth for fifteen seconds, then removed with water in a syringe. Roots should be scaled after the pockets are partly or wholly eliminated, to avoid tissue laceration and metastatic transmission of infective elements. The third cleansing operation, which is scarcely necessary but adds to the effectiveness and nicety of treatment, consists of drying the roots with ethyl absolute alcohol and treating them, first with a saturated solution of zinc sulfate, followed by a saturated solution of barium hydroxide.

SPECIAL INSTRUMENTS

Special instruments are not necessary, but add to the effectiveness of the work. They consist of a slough remover (7), two packers (1), five chisels (2, 5), seven scalers (3, 4, 5) and a long, blunt explorer. (Fig. 7.)

HOME CARE

The patient is given instruction in brushing, including the use of a small single tufted brush (Fig. 10); taping the roots at the gingival margin with dental ribbon; deep finger pressure over the roots, and rinsing with cold water for tone.

DIET

The diet is left largely to the judgment of the operator or the physician.[8] Instructions relate to quantity, weather changes, vitamin elements, habits of living and special foods for the systemically involved case, such as the diabetic. The oral tissues tend to become irritated during weather fluctuations, especially when these occur in warm seasons, in the fall and spring. At such times, "colds" develop, and, with them, acute inflammatory conditions of the gums, tongue and buccae are manifested. It is well to reduce the food intake considerably in this instance, and the oral tissues respond at once. At the same time, 5-grain or 3-grain doses of quinine sulfate with 10-grain doses of phenyl salicylate are helpful. Brushing the teeth, tongue and gums once a day with a 2 per cent solution of sulfarsphenamine in glycerin or diethylene-glycol is very helpful in inhibiting these exacerbations. Ulcerated surfaces may be lightly stroked with liquefied phenol.

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CONTROL OF WAX DISTORTION BY MANIPULATION

By R. L. LASATER, D.D.S., Evanston, Ill.

IN October 1937, F. S. Meyer issued a challenge to the profession by stating that "no casting in gold has ever been made, is being made, or will be made to the accurate dimensions of a wax pattern." In the next paragraph, he adds that "no perfect wax pattern has been made, is being made, or will be made to the accurate dimensions of a cavity in the mouth." Certainly, greater strides have been made in the last ten years in casting to accurate dimensions than in impression taking to accurate dimensions. The primary object of this paper is, therefore, to discuss not the normal contraction and expansion of inlay waxes, but their distortion from stresses and strains, in order to arrive at a technic that will partially meet the foregoing challenge.

As an aid to studying and charting this distortion, an apparatus was constructed similar to that of Maves,[2] which consists of a water bath containing an inlay pattern, an image of which was projected on a screen made of bond paper, and tracings made of this real image on the paper. The temperature of the water bath is then changed by circulating hot water from an electrically controlled heating element, from 70° to 135° F., tracings being made at various temperatures. Maves demonstrated the distortion of all wax patterns when heat is applied, but failed to correlate his results in favor of any single technic.

Read before the Section on Operative and Preventive Dentistry at the Seventy-Fifth Annual Midwinter Meeting of the Chicago Dental Society, February 14, 1939.

The distortions demonstrated by Maves are obviously linked in some manner with the molecular or atomic constitution of the wax. It is therefore logical to assume that the method of manipulation will have considerable effect on the resulting release of stresses and strains.

The mesioclusodistal type of inlay pattern has been selected because of the complicated distortions that occur from this type. All types and kinds of waxes have been used, and 150 models have been studied. The figures that are shown are divided into four different series: Series A, waxes heated by the usual technic of manipulation over an open Bunsen flame, worked with the fingers and placed in the matrix and in the prepared cavity; Series B, those wax patterns that are completely fused and poured into the matrix already placed on the tooth; Series C, those that are heated at a predetermined temperature in an enclosed dry electric oven, and Series D, those submitted to decreasing temperature in the water bath; with additional miscellaneous figures.

Wax III, Series A (Fig. 1), which was heated over an open flame, demonstrates the distortion of a soft wax or one that does not meet American Dental Association specifications. Series A, Figure 2, outlines a wax that does meet American Dental Association specifications. It shows a great deal less distortion, but still cannot be considered satisfactory or acceptable as an accurate impression. Wax III in Series A (Fig. 1), shows the great distortion of a soft wax at a comparatively low temperature. Series A,

Figure 3, shows the slighter distortion of harder wax at a higher temperature and with a double sprue pin.

Large two surface and mesioclusodistal inlays should have double sprue pins as outlined and shown in Figure 3. In order to better understand what happens when a wax impression is removed from a cavity, a model of a lower first molar with a mesioclusodistal cavity was constructed from a translucent (clear) mounting material in order to see all the inner surfaces of the wax pattern. This

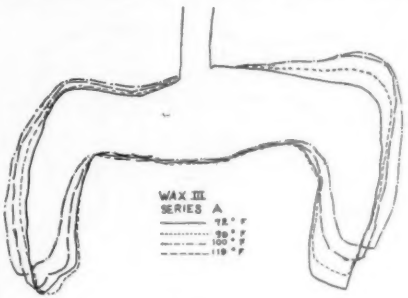

Figure 1.

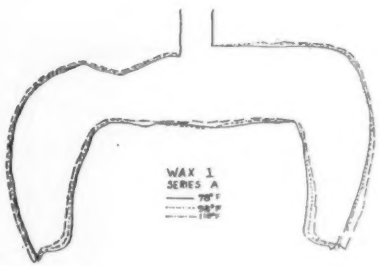

Figure 2.

mounting material is methyl-methacrylate, a resin known as lucite. On removal it was noted that if a sprue pin is placed in the middle of the mesioclusodistal pattern and that part directly beneath is pulled, the sprue pin section loosens first and pulls with it the adjacent portion of wax, and thus the gingival portion is distorted and caused to flare. Therefore, more accurate impressions of all three surface cavities can be taken by removing the wax with a multiple sprue pin, if an attempt is made to sprue them in the mouth, and any other method of removal necessitates additional handling, increasing the chances of wax distortion. Figure 3, Series A, shows the partial control of this distortion by double sprue pins. This has been demonstrated in actual castings. At this point, it should be stated that the distortion temperatures employed in this study are not all necessarily met with in modern casting meth-

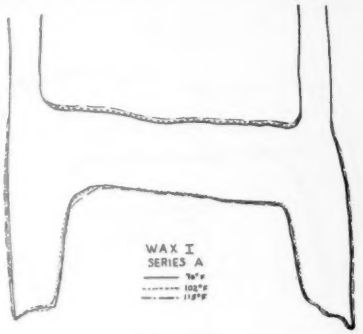

Figure 3.

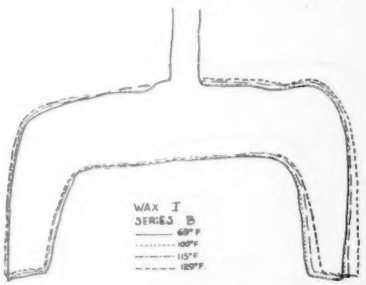

Figure 4.

ods. These temperature values have been selected arbitrarily as a means of studying relative distortional effects under various methods of manipulation.

In the previous figures, it has been quite evident that the distortions were great and that the wax had not been rendered homogeneous by heating over an open flame and mulling with the fingers. One method of rendering the wax homogeneous is to melt it.

Wax 1 in series B (Fig. 4) shows less distortion than previous figures even though the temperature is raised to 129° F. This distortion is outward. In Wax 1 in series B (Fig. 5), there is comparatively greater distortion at 95° F., and the distortion is outward. Figure 6 (Series B) shows almost as much distortion at 98° as at 110° F. It may here be definitely stated that waxes heated throughout to a predetermined temperature and allowed to cool will become distorted when they are again heated as they approach the former predetermined temperature to which they were heated.

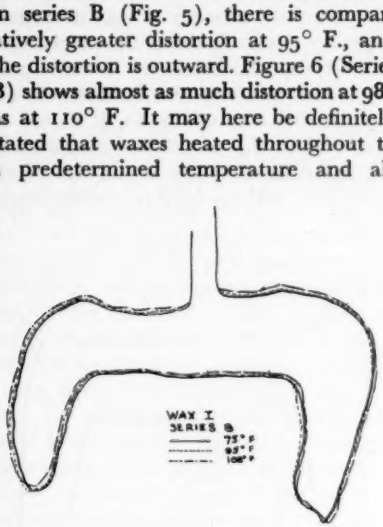

Figure 5.

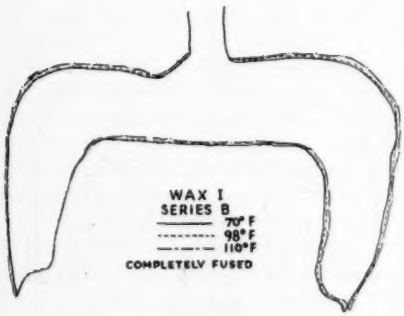

Figure 6.

For comparison with other methods to be described, it is noted that the distortion of the step portion of the pattern is outward in all these melted waxes. It is evident that homogeneity of the wax during manipulation and cooling is essential to less distortion.

Obviously, any method which employs molten wax is not practical for any use in the mouth and, at present, most of the inlays are made by the direct method. Therefore, we must seek another way of securing homogeneity.

Let us see how some of the authorities manipulate waxes. Robert K. Brown, at this meeting one year ago, said:

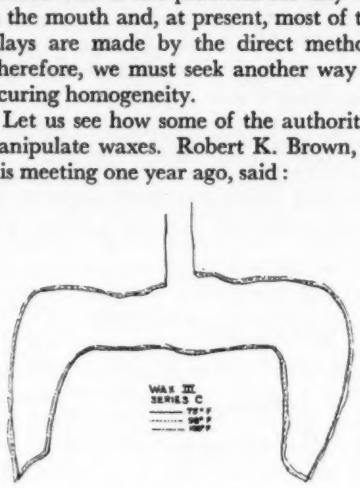

Figure 7.

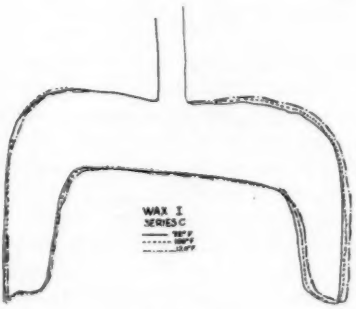

Figure 8.

Since wax that has been thoroughly softened or even melted is in a non-resistent state and is less susceptible to these reactions, it appears that melted or poured wax would give more accurate patterns than softened or manipulated wax. Some operators have proved that wax that has been melted or poured into a mold and then been allowed to cool to room temperature without any pressure has the least distortion even when temperature changes do occur, and conversely a manipulated wax is distorted more

with less temperature change than is a poured wax.

Robert P. Dressel stated in the *Dental Cosmos* (1930):

There are two methods of softening the wax to a working consistency; the use of dry heat (open flame) or use of moist heat (water bath). The dry heat method, while not at all practical, is perhaps used by the majority of operators. Wax softened over an open flame, unless the operator exercises extreme care, renders the wax almost unfit for further use. The outside surface melts quite readily; the wax just outside of that is soft, while the under core of wax is still hard.

C. S. Van Horn, in commenting on the foregoing, says:

I here assert that relatively that is exactly the condition of the wax desired and the most favorable to perfect adaptation. I ask why should wax lose its working properties once it has been melted? How could pattern wax be compounded and marketed if it were not melted and molded into cones, sticks, and so forth?

E. W. Skinner, in his book on dental materials, writes:

The wax further exhibits the peculiar properties of distorting elastically at higher temperatures than the temperatures at which it is adapted. For example, if a stick of inlay wax is softened at a definite temperature and bent into a horseshoe shape, as before chilled in that position and placed in a water bath, the temperature of which is gradually raised the wax will begin to distort at or slightly above the temperature at which it was manipulated. Distortions of this type can be partially avoided by manipulating the wax at the highest practicable temperature.

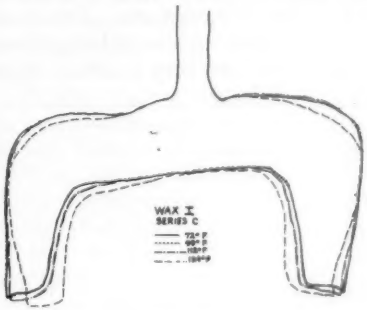

Figure 9.

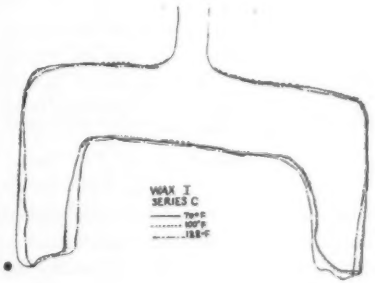

Figure 10.

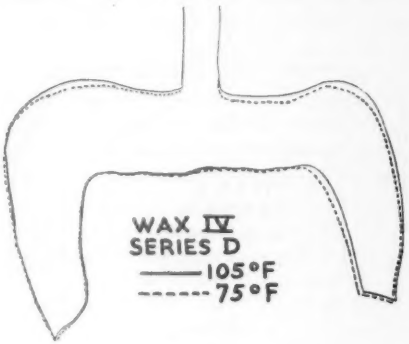

Figure 11.

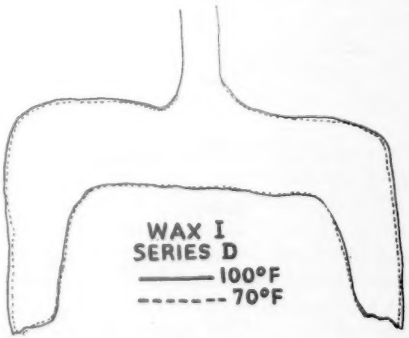

Figure 12.

Carl H. Scheu says:

When inlay wax heated to the lowest possible temperature that will permit easy manipulation, is forced into a cavity and held under pressure, there is an average shrinkage of 0.4 per cent. When liquid wax is used, the shrinkage is generally from 0.6 to 0.8 per cent. Impressions made with a syringe show a shrinkage as great as 1.6 per cent. None of these patterns show loss of detail

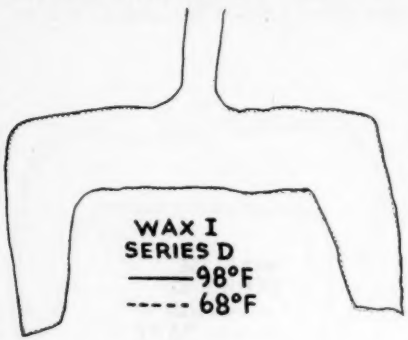

Figure 13.

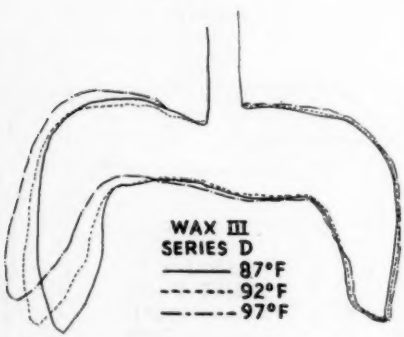

Figure 14.

on visual examination, which shows the futility of selecting a technic visually.

F. S. Meyer again states:

We soften this wax either over flame or in hot water. I cannot see that it makes a great deal of difference which method we employ.

Robert K. Brown again states:

My experience when making wax patterns for the Bureau of Standard dies, that were used for checking various inlay techniques several years ago convinced me that poured waxes were the most accurate.

Thus it can be readily seen that at the present time, there is a great difference of opinion and variance in the technic of preparing wax for the cavity.

Let us examine the next series of waxes, prepared for the cavity by heating in a dry electric oven to temperatures ranging from 150° to 115° F., in order to render them homogeneous. The waxes are then treated as above by being placed in the matrix and then in the prepared

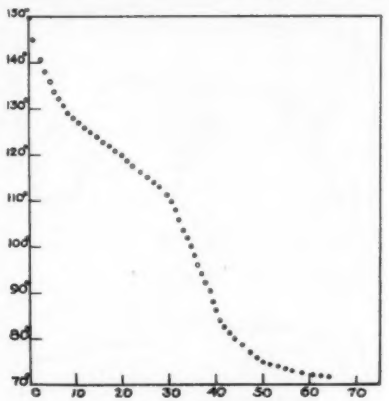

Figure 15.

cavity, and cooled in room-temperature water under pressure. The distortions resulting are shown in the next four figures. The step portions in those waxes heated to above 130° F. move outward with increase in the bath temperature and those heated from the lower temperature move inward. Figure 7 (Series C) outlines wax heated in an oven to 138° F.; Figure 8 (Series C), wax heated in an oven to 150° F.; Figure 9 (Series C), wax heated in an oven to 122° F., and Figure 10 (Series C), wax heated in an oven to 120° F.

There is very little distortion up to 100° F.

From a clinical standpoint, the least distortion that has occurred so far has been evident in those patterns the temperature of which has been kept at the lowest possible working range. At first glance, it might be concluded that the distortion is greater than before, but, from a clinical standpoint, they are the least with any method. In modern technic, the wax pattern is not likely to be subjected to temperature greater than that of the mouth before the initial set of the investment. No distortion occurs in those waxes heated in an incubator to low temperatures until the heat is above mouth temperature. It should be further noted that when distortion does occur, the step portions move inward; as, when the wax was manipulated at higher temperature, the step portion moved outward. These effects of difference in manipulation temperature have been observed time and again and are clearly established.

In order to study the effects of contraction of the wax, patterns prepared by the previously mentioned technic were subjected to decreasing temperature changes in the water bath. The following graphs show the degree of contraction when the wax is heated in the various manners: Figure 11 (Series D), wax heated over flame placed in water bath and allowed to cool to 75° F.; Figure 12 (Series D), wax completely fused, placed in water bath cooled from 100° to 70° F.; Figure 13 (Series D), wax heated in an incubator to 123° F., and cooled in a water bath from 98° to 68° F. Figure 14 (Series D) shows what happens when the pattern is broken and an effort is made to mend it. Under no circumstances should we try to repair the wax pattern.

It may be concluded, therefore, that the wax should be manipulated at a low temperature rather than at a high temperature, as formerly supposed, in order to assure minimum distortion. However, if this method is employed, it should be stressed that wax must be softened gradually in air at the proper temperature in order to obtain complete homogeneity.

In order to establish a method for the testing of a wax in connection with these effects and, at the same time, to obtain a theoretical background, if possible, an attempt has been made to correlate the manipulation temperatures with cooling phenomena. Figure 15 shows one of the time-temperature cooling curves of three waxes employed in this study. In every case, either an arrest point or else a range of temperature that exhibits an arrest in cooling can be observed. Furthermore, these arrest temperatures occur below the fusion temperatures of the waxes. Such phenomena are usually indicative of the presence of a crystalline phase. In correlation with the previously mentioned experiments, if the wax is manipulated at temperatures above the arrest temperatures, more distortion occurs than if the manipulation is carried out at temperatures below the arrest points.

In seeking to explain why this occurs from a theoretical standpoint or on the basis of the laws of physics, I appealed to E. W. Skinner, physicist at Northwestern University Dental School, who explained this phenomenon somewhat as follows:

It is postulated that an inlay wax cannot be treated as an amorphous structure, but must rather be treated as one that is partially crystalline and partially amorphous. When the wax is heated above the arrest points, the thrust of the crystalline growth introduces stresses, which may be absorbed temporarily by the amorphous phase. During their release by temperature change, the distortion will be outward, as originally occurred.

On the other hand, if the manipulation is carried out at the lower temperature, the crystalline phase will not be greatly changed. The residual elastic stresses introduced into the amorphous phase by the confinement across the occlusal portion of the pattern will naturally cause

any distortion to occur inward. However, since the rigidity of the crystalline phase is greater than that of the amorphous phase, the latter is neither so sensitive to temperature changes, nor of such magnitude as the former distortion, which occurs as a result of the solidification of the crystalline phase. The conjectures are verified by experimental data in every case.

The natural question then would be: What is the best technic for the control of wax distortion? A simple procedure used in my office for more than two years and giving very satisfactory results is as follows: Given a well-prepared mesioclusodistal cavity free from undercuts and with walls smooth on all surfaces, a copper band or steel matrix is trimmed to fit the tooth and the opposing teeth. This matrix band should be slightly larger than the tooth on which it is to be placed in order to allow for excess wax and burnishing.

An oven containing the wax has been kept at 122° F. for at least fifteen minutes previous to manipulation. The matrix material is likewise kept in this oven. The wax is then placed in the matrix and a very small amount of melted wax is added at the points on the wax in the matrix that come in direct contact with the gingival portion of the cavity. This wax is always softer or of a lower fusing point than the main body of the wax employed. The matrix containing the two waxes is then placed on the tooth and, in most cases, the patient is instructed to "close" The whole mass is then cooled with room temperature water and removed. The pattern is examined carefully and, if all detail is registered, the excess is removed and the pattern replaced in the tooth for accurate carving and burnishing. I prefer to adapt the gingival portion first with smooth strips of China silk, reheating as little as possible. The occlusal portion is carved as nearly to anatomic tooth form as possible, and when it is necessary to add wax or reheat it, this is done with the greatest caution, with care to in no way disturb the bulk of the wax proper.

Double sprue pins should be used on all mesioclusodistal patterns and a small amount of sticky wax be added to their ends before they are placed in wax patterns in the cavity in the mouth. The pattern is then removed in this way and invested.

CONCLUSIONS

1. Uniform heating of wax is imperative for a minimum of distortion.

2. Variation in temperature in heating the waxes resulted in different types of distortion. High temperatures (above 130° F.) distort outward, and low temperatures (below 130° F.) distort inward.

3. It is evident that the arrest periods in the time-temperature cooling curve bear some relation to the distortion of the material.

4. In the three or more surface cavities, multiple spruing is advisable as an aid in controlling distortion.

5. The best temperature for heating wax for manipulation is 122° F. In no case should a wax be manipulated by softening over a Bunsen flame as is practiced today. It will exhibit temperatures above and below its arrest temperature throughout its mass. This method shows that a great inhomogeneity results and distortion is greater than with any other method employed today.

6. The less the molecular arrangement of the wax mass is disturbed, the less the future distortion.

Taking account of these findings and manipulating the waxes accordingly will aid in attaining a perfect impression of a cavity.

636 Church Street.

DISCRIMINATION IN THE STATUS OF PULPLESS TEETH

By Clarence O. Simpson, M.D., D.D.S., St. Louis, Mo.

EXCEPTING the revelations of radiography, the most revolutionary influence upon dentistry in this generation has been the opinions and procedures regarding pulpless teeth. The extremes have varied from the belief that the pulp was useless and constituted a risk in a completely formed tooth, to the belief that any tooth without a pulp should be removed. Within this period, it was considered malpractice to crown a tooth without removing the pulp, and later it was considered malpractice to remove a pulp instead of the tooth. Now it is considered malpractice to remove a pulp, if it can be safely retained. Such radical changes leave stragglers who cannot become adjusted and who remain prejudiced exponents of past follies.

The generalized denunciations by Hunter and the specific charges by Billings were largely responsible for the inception of the pulpless tooth phobia, which was given further impetus by the reports of Rosenow, Price and Hayden. The aggressive statements of Hunter led most physicians to believe that gold crowns were infallible markers of septic teeth, and the emotional appeals of Price led most dentists to believe that all pulpless teeth were sources of disease. The result of this pernicious propaganda was an era of fanatical sacrifice of harmless teeth, for which many porcelain tombstones stand as memorials. The convincing investigations of Hatton and the sound arguments of many clinicians and writers reassured rational dentists that all pulpless teeth were not pathogenic.

The majority of physicians have transferred their enthusiasm to allergy and have forgotten oral foci, although septic teeth still impair the health of their patients. Allegedly thorough physical examinations are made and prolonged treatment is unsuccessfully applied without investigation of dental conditions, which may be a factor in illness. Many dentists are efficiently treating selected pulpless teeth by scientific methods, as all dentists should be able to do. Some dentists from laziness, fear or selfish motives are evading the issue by leaving pulps in jeopardy or removing the affected teeth. Previous to the extensive use of radiography, the condition of pulpless teeth was judged by symptoms. If they did not cause discomfort, swelling or visible suppuration, they were considered safe. Some dentists and many patients still advocate this disproved theory by exonerating such teeth with the statement "They have never given any trouble." After radiography had disclosed the prevalence of periapical destruction, and clinical evidence had demonstrated the effects of these septic foci, there was a tendency to assume that all pulpless teeth were diseased. Many dentists and some patients still advocate this disproved theory by condemning pulpless teeth with the statement "I would not keep a dead tooth in my mouth." Between these diverse and arbitrary positions is a field for judicious discrimination.

Read before the Section on Oral Surgery, Exodontia and Anesthesia at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 20, 1939.

For a pulpless tooth to be a source of infection, the canal must be invaded by bacteria, there must be a suitable environment for the propagation of these bacteria and there must be an exit for the bacteria or their toxins. Therefore, there are several possibilities which may prevent pulpless teeth from being pathogenic: 1. The canals may not have been invaded by bacteria. 2. If bacteria have invaded the canals, they may have become extinct from a lack of suitable environment. 3. Canals which were septic may have been subsequently rendered sterile by instrumentation or the use of antiseptics. 4. The apical foramina may have been imperviously sealed by artificial filling material or osteoid tissue, or through pulp calcification, or hypercementosis. 5. The vital resistance may nullify the action of the bacteria or the infective virus emanating from a pulpless tooth.

Since some of these possibilities become realities and all pulpless teeth have not been proved pathogenic, it is quackery to condemn them indiscriminately. Since these possibilities may not be realized, and some pulpless teeth have been proved pathogenic, it is quackery to ignore them indiscriminately. The three methods used to determine the status of pulpless teeth are clinical, bacteriologic and radiographic. The subjective and objective symptoms are often sufficient for the diagnosis by clinical means of acute infection from septic degeneration of pulps. The pain stimulus may be deceptive because of reflex distribution or localization, but tenderness is generally more dependable. Localized swelling is a diagnostic sign apt to develop when treatment is deferred. After drainage or removal of a septic pulp, chronic periapical infection often persists. This condition is sometimes revealed by a fistulous opening, an indurated swelling, the mobility of the tooth or discomfort from vigorous occlusion. However, the majority of chronic periapical infections are symptomless and cannot be discovered clinically. In few other locations is chronic infection so nearly devoid of local symptoms as in periapical areas. A common clinical fallacy is the conclusion that any improvement following removal of pulpless teeth proves the pathogenicity of the teeth. This assumption of cause and effect disregards other therapeutic measures applied concurrently, the tendency of disease to periods of abatement and the fluctuations in physical resistance. Such deductions of specificity present a vast discrepancy from Koch's postulates.

The bacteriologic diagnosis of pathogenicity of teeth depends on cultures obtained from the canals, the periapical tissues or excised root ends. Positive cultures from canals or excised root ends do not prove that bacteria or bacterial toxins have passed through the apical foramina and caused infection. Positive cultures from periapical tissues do not exclude contamination or prove the presence of disease, which is contingent on the virulence of the bacteria, local susceptibility and impaired systemic resistance. When apical foramina can be closed to the egress of canal contents, and when pathogenic bacteria can be obtained from gingival crypts, positive cultures from and around pulpless teeth are not proof that they are sources of infection.

Radiographic evidence of pathogenic teeth consists of characteristic abnormalities of the periapical structures. In contrast with clinical evidence, which is so seldom present, and bacteriologic evidence, which is only one factor in the production of disease, radiographic evidence indicates a pathologic reaction to infection or the effects of disease. Pathologic alteration of tissues is a common manifestation of organic disease, and, in many instances, there are typical lesions. The anatomic features of alveolar bone and its accessibility for radiographic examination are especially conducive to

obtaining evidence of involvement from septic teeth. The *lamina dura,* or compressed layer of bone surrounding the roots of teeth, is the cardinal diagnostic index, but the trabecular pattern and the comparative radiability of the bone are also significant data.

The reliability of radiographic evidence is apparently established by the consistent periapical destruction following septic degeneration of pulps, and the restoration of normal periapical structures after the source of infection has been eradicated, as bone does not completely regenerate in the presence of infection. From this sequence, it is logical to conclude that septic teeth affect the adjacent structures before more remote locations by metastasis and that periapical conditions indicate whether teeth are pathogenic. Except for traumatic osteoclasia and rare alveolar anomalies, periapical radiolucency and destruction of the *lamina dura* are not associated with normal teeth or some pulpless teeth. After the exclusion of traumatic osteoclasia and alveolar anomalies around a tooth from which the pulp has not been removed, periapical radiolucency and destruction of the *lamina dura* are proof of the presence of a septic pulp, although it may still respond to vitality tests. Since these changes arise from teeth with septic pulps, but not from normal teeth, it is reasonable to believe that such involvement from pulpless teeth proves that they are pathogenic; while normal periapical structures demonstrate that pulpless teeth are innocuous. This is the most feasible process of discriminating regarding the status of pulpless teeth, and the application of it in condemning teeth is sufficiently radical, since bone regeneration is not always perfect after the elimination of infection. While normal periapical structures indicate the absence of disease, defective periapical structures are not always diseased, although for safety they must be so considered.

The error in determining the status of pulpless teeth by radiography is not due to deficiencies in the art, but to deficiencies of the artists who make and interpret the radiographs. Proponents of the theory that all pulpless teeth are pathogenic maintain that miraculous cures result from the removal of teeth which were "radiographically negative," and therefore that radiographic evidence is not reliable in determining dental foci. In many of the instances observed, the radiographs were so inferior that the evidence instead of the teeth, it should be stated, was "radiographically negative." Ottolengui once asked, "Who would declare that tissues were 'microscopically negative' if the sections were blotched, the staining was poorly done, and the microscope lenses were out of focus? Why be less exacting of radiographic diagnosis?" It is easier to sacrifice teeth and proclaim a false doctrine than to obtain reliable radiographs. No one who does not recognize and has not the ability to produce or the facilities to procure adequate radiographic evidence should decide whether teeth are to be removed or retained. Radiography is the only preoperative means of determining the effect of most pulpless teeth, and it should be used for this purpose instead of merely to discover and condemn all pulpless teeth.

The radiographic proof of periapical infection verified by the acute symptoms and the presence of a septic pulp may be appropriately applied to chronic infection. This is thickening of the periodontal membrane with distention of the *lamina dura* around the apical portion of the root, usually followed by destruction of the periapical *lamina dura* and the adjacent trabeculae. After the involvement becomes chronic, there probably will be complete destruction of the periapical bone in an area 3 mm. or more in diameter, which, after a year, may be surrounded by a radiopaque zone of condensing osteitis and may cul-

minate in resorption of the root end. Considerable loss of periapical bone does not necessarily signify the destruction of the periodontal membrane, as infection can pass through without obliterating the membrane. Root resorption incident to chronic periapical involvement first demonstrates radiographically the destruction of the periodontal membrane, although it has occurred some time before. The density and trabecular pattern of regenerated periapical bone may not be identical with that of the original bone, and the *lamina dura* is not always distinctly restored; allowance for which must be made in critical decisions.

To distinguish these diagnostic features, there are fundamental radiodontic requirements which are too generally disregarded. The roots of the teeth and the periapical structures must be revealed clearly in different aspects. Large periapical involvements can be obscured in ordinary radiographs by superimposed images or by incorrect angulation. Even with excellent radiographs, greatly divergent views within the permissible range are necessary, one of which should be through the labiolingual or buccolingual diameter with the images approximating the true length of the roots. The images must have sharp definition and moderate contrast to disclose the precise outline and comparative radiability or density of the anatomic details. The unaided eye cannot discern all of the information in an intra-oral radiograph, because the structures are too minute and too closely associated. Magnification of two or three diameters affords a different conception, by clarifying and separating the images. With insufficient contrast, much of the detail is obscured, while excessive contrast fails to register the maximum detail.

Excellent radiographs can be produced, but not by chance or careless operating, only by intensive application of correct technical procedure. The value of a radiodontic examination is in direct proportion to the skill employed in making the radiographs and the experience and knowledge exercised in interpreting the evidence. In no other branch of dentistry is the patient so little able to judge the quality of service or the dentist so able to conceal deficiencies in technical skill as in radiodontic examinations. The absence of compulsion to render adequate service explains the prevalence of the radiodontic "racket," which has developed from the use of x-ray machines by unqualified operators. The diagnostic blunders which frequently result from incompetent examinations are less harmful than the neglected possibilities for service and the false sense of security which patients experience from having had the teeth radiographed. Dentists with x-ray machines which they do not know how to use or do not use sufficiently fail to give their patients the benefits of radiodontic service and prevent them from obtaining the service elsewhere. Since individual ambition and pride are usually insufficient to overcome human inertia and stupidity, the only hope of materially improving the general practice of radiodontics is by forcible, constructive criticism within the dental profession. The essential skill can be acquired by any competent dentist, but not by assimilation or idle wishing. Radiodontics is as definitely systematized as any department of dentistry for those who have the will to learn it and are not satisfied with bungling pretense.

The failure to discriminate regarding the status of pulpless teeth is often due to combining defective radiographs and erroneous interpretation, the sum of which is absolute zero in an accuracy score. With observers who are "afraid of the dark," any radiolucent area, whether produced by rarefying osteitis, medullary space, anatomic superimposition or artefact, is proof of infection. They should whistle for courage to pass the dark spots. Disciples of the pulpless tooth crusade can always conjure up

proof to condemn any tooth with a canal filling, but if all of the images except the periapical region were covered, they would not know which tooth to condemn. Ultraconservatists dismiss all areas of destruction less than 5 mm. in diameter as "not very bad." They should learn that chronic periapical involvements seldom become bigger or better spontaneously.

A definite periapical destruction that is not attributable to another condition should be considered as evidence of infection, and the affected tooth either should be successfully treated or removed without waiting for systemic disorder. When normal periapical structures can be demonstrated by radiographs of the requisite quality and number, a tooth should not be considered a source of infection or removed because of canal conditions. When there is an apparent prospect of improving canal conditions in such teeth, it should be attempted by thorough treatment and filling, as they may become septic after being innocuous for years.

The prime reason for discrimination in considering pulpless teeth is to retain for service those that are harmless, and many such teeth have been sacrificed by error. It is the obligation of dentists to eradicate and prevent disease, then to conserve or restore masticatory function. If dentists performed canal operations as efficiently as they could, there would be fewer septic teeth. However, the basic solution of the pulpless tooth problem by dentists is the repair of carious teeth before pulps are endangered. Except for negligence of patients in seeking dental inspection, dentists are responsible for nearly all pulpless teeth. In failing to utilize radiography to discover incipient caries, deferring repair of carious teeth and disregarding pulp conservation in the preparation of vital teeth for restorations, dentists are accountable for the loss of many pulps, an inexcusable breach of confidence and duty. It would be amusing to hear the fictitious explanation for a pulp involvement by caries made to a patient who has dental examinations semi-annually. In these instances, it is obligatory to make an attempt at a canal operation to mitigate the disaster. If this attempt is no more effective than the preventive service, there is a probability of a septic tooth, which must be retained to conceal the crime.

Hence, there are self-protective reasons for some dentists to ignore obvious radiographic evidence of infection from some teeth, or to maintain a clear conscience by never investigating the results of their canal operations. Some dentists do not remove any tooth unless it is compulsory, presumably because they wish to avoid labor, since they so often advise against replacements. Upon viewing radiographs of the mouth of one of his best patients, a dentist recently said, "Curses on the x-rays, they show so much hard work to be done." There are suspicions that some other dentists remove teeth on the slightest pretext because they wish to construct replacements. A lawyer stated that he did not want a radiodontic examination by an exodontist who served as prosecutor, judge and executioner with a fee contingent upon execution, because he wanted a fair trial of his teeth. Unjust censure can be avoided by securing decisive radiographic evidence for any one to see, and by interpreting the evidence according to present knowledge and the precepts of the Golden Rule instead of being influenced by erratic theories and questionable motives. To avoid censure, there must be a marked improvement in the general standard of radiodontic service, which is attainable for all dentists who have the necessary ambition and properly directed energy.

University Club Building.

EFFECT OF VARYING CONDITIONS ON THE TIME REQUIRED TO CAST GOLD UNDER AIR PRESSURE

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THE difficulty of successfully producing castings of relatively extended areas in proportion to their thickness may be explained in part by the failure of the metal to stay molten sufficiently long to complete the casting, unless it is superheated to a degree where its physical properties are detrimentally affected. Under customary conditions of dental casting, the temperature of the walls of the pattern chamber is below that of the molten metal at the instant that it is injected into the mold. Consequently, there is always a tendency for the advancing portion of the metal to congeal before it reaches the farthest or thinnest recesses of the mold cavity. It is evident, therefore, that the rapidity with which the molten metal enters and spreads throughout the pattern chamber is of considerable importance in successful casting practice.

It has long been assumed that the time required to cast molten metal varies with the number, length and cross-sectional area of the sprues; the temperature of the flask and of the molten metal; the volume and shape of the pattern chamber; the porosity of the investment material, and the character of the pressure applied. Thus, a knowledge of the effect of these conditions on the time required to cast gold is essential in the design of equipment, the formulation of materials and the development of technical procedures for casting.

In 1933, Souder[1] reported an experiment in which he measured the time required to cast dental prostheses from molten alloy by photographing, through quartz windows, the entry of the molten gold alloy into the cavity. Without tabulating the results, Souder concludes that most dental castings are completed in from one-tenth to one-twentieth second.

In 1937, Herbert and Thompson[2] reported an electrical method of determining the rate of filling of a mold space under steam pressure. The measurements were made by tracing the movements of an electromagnet and a tuning-fork on a revolving smoked drum. While few data are presented, the summary includes the statement: "The time taken for the gold to fill the mold space is of the order of one-tenth second."

Although the work of Souder and Herbert and Thompson represents distinct contributions to the science of dental casting, a measure of time as such appears to be limited in practical value without a knowledge of the effect, on the time required to fill the pattern chambers with molten gold, of varying the specific conditions under which the castings were made.

It was the purpose of this investigation, therefore, to measure the effect of the following conditions on the time required to cast gold under air pressure: (1) degree of air pressure; (2) capacity of air storage tank; (3) normal and induced leak-

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age of air pressure; (4) cross-sectional area, shape, length and number of sprues; (5) temperature of molds and of casting gold; (6) age of molds; (7) use of new or remelted casting gold, and (8) volume of pattern chamber.

METHOD

To measure the rapidity with which this casting operation is effected will necessitate a determination of the time interval between the application of pressure to the surface of the molten metal in the crucible and the instant that the pattern chamber is completely filled. In the present investigation, this interim was measured by breaking an electrical circuit simultaneously with the admission of air pressure to the crucible and making the circuit again by contact of the molten gold with platinum-iridium wires embedded in the pattern chamber. These break and make impulses were transferred through the writing point of a signal magnet and recorded on a revolving smoked drum. The interval was measured by tracing the vibrations of a writing point attached to one arm of an electrical tuning-fork, across the recorded impulses of the signal magnet and dividing the number of vibrations between the break and make impulses by the known frequency of the fork. Thus, these measurements could be made accurately and simply without departing in the least from the conditions of ordinary casting practice.

Table 1.—Time Required to Cast Gold Through 11-Gage (B&S) Sprues Under Pressures of 5, 10 and 20 Pounds per Square Inch

11-Gage (B&S) Sprues				
No.	Vibrations	Time (Seconds)	P_1-P_2 (1 Cm.) (Seconds)	Weight (Grains)
		20 Lb./Sq. In.		
1	2.5	0.032	35	83
2	2.5	0.032	40	82
3	2.5	0.032	37	81
4	2.0	0.025	43	82
5	2.5	0.032	45	83
6	2.0	0.025	40	82
		10 Lb./Sq. In.		
7	3.0	0.038	85	82
8	3.5	0.044	86	83
9	3.0	0.038	90	82
10	3.0	0.038	90	81
11	3.5	0.044	89	81
12	3.0	0.038	92	82
		5 Lb./Sq. In.		
13	5.0	0.063	90	82
14	5.0	0.063	90	81
15	5.0	0.063	100	80
16	5.0	0.063	86	80
17	5.5	0.069	87	81
18	5.0	0.063	85	82

APPARATUS

1. *General Description.* — The apparatus viewed as a whole is shown in Figure 1. Its various parts are graphically

represented in Figure 2. It consists of seven units designated, from right to left, as follows: (1) a compressed air storage tank provided with a mechanical reducer intervening between the tank and a pressure supply line of thirty pounds per square inch, a two-way valve permitting adjustment of the tank pressure and communicating with the casting machine and a rubber hose connecting the tank with a manometer; (2) an open tube mercury manometer by means of which the pressure could be accurately read to a fraction of a pound per square inch; (3) the casting machine, provided with a circuit-breaker actuated by air pressure, and the necessary electrical connections; (4) dry cell batteries to supply energy for the

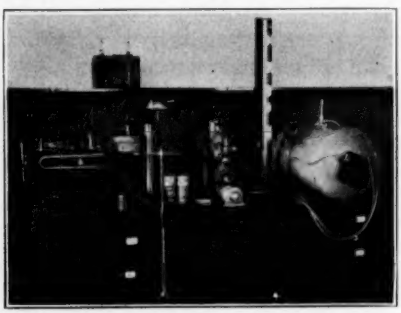

Fig. 1.—General view of apparatus used in investigation.

break and make circuit; (5) a ring stand supporting a horizontally placed signal magnet with an attached writing point; (6) an electrically operated kymograph, and (7) an electrical tuning-fork driven by a 6-volt storage battery and provided with a writing point.

2. *The Molds.*—A prepared pattern ready for investing is shown in Figure 3. The pattern was carved from inlay wax to the desired dimensions and attached to a metal sprue former. This was in turn mounted on a crucible former and adjusted to form a sprue of the desired length. A piece of 18-gage (B&S) wax wire, 7 mm. in length, was attached to the upper surface of the pattern at its periphery to serve as a contact tip. (The term contact tip will hereafter be used to describe this projecting piece of wax wire, the dimensions of which were kept constant throughout the course of the investigation.) The specifications of this contact tip with respect to gage, length, attachment and direction were determined by preliminary experiments. A stainless steel flask provided with a small hole on each side was placed on the crucible former and adjusted in such a manner that the contact tip of the pattern would be equidistant between the two holes. The flask was then sealed to the crucible former with sticky wax. Platinum-iridium wires (22-gage B&S) were passed through the holes in the flask and sealed to the extremity of the contact tip without being allowed to contact each other.

The investment material used in all of the tests was an American Dental Association specification type. It was mixed with a water: powder ratio of 0.30, mechanically spatulated and vibrated into the flasks.

The molds were heated in an electric furnace. The recorded temperatures in the various tables were determined by preliminary tests with thermocouples invested in the center of the flasks and are accurate to $\pm 20°$ C.

3. *The Casting Machine.*—Figure 4 shows a commercial dental casting machine with the necessary mechanical alterations and attachments to meet the requirements of the investigation.

4. *The Air Circuit-Breaker.*—In order to insure that the breaking of the electrical circuit would occur simultaneously with the admission of air pressure to the crucible, it was necessary to design a circuit breaker which would be actuated by this same pressure and prevent leakage of air during its operation. The device, illustrated in Figure 5, is attached to the casting machine by means of nipple C and connects with the air passage be-

tween the valve and sealing cap. During operation, air passes through the opening C, raises the plate D and breaks contact between screw L and plate H. The rubber washer E prevents leakage of air around the opening through which the rod F passes.

5. *Equipment for Measuring Time.*—The time interval measurements were made with an electrically operated tuning-fork and motor kymograph. (Fig. 6.) Below the white bands on the smoked drum of the kymograph are two writing points, one attached to the upper arm of the tuning-fork and the other to a signal magnet. The tuning-fork, driven by a 6-volt storage battery, has a frequency of seventy-nine vibrations per second, and the tracings recorded on the drum of the kymograph can easily be counted with the aid of a small lens. A typical tracing is shown in Figure 7. Since the drum of the kymograph revolves in a clockwise direction, the readings are made by counting the number of recorded vibrations beginning with the break in the upper line on the left and ending with the break in the lower line on the right. It will be noted in the illustration that the recorded vibrations of the tuning-fork are sufficiently separated that the tracings of the signal magnet can be read between two vibration lines. Since the distance from one line to another corresponds to one seventy-ninth, or 0.0126, of a second, half the distance is equivalent to one one-hundred-fifty-eighth, or 0.006, of a second. In all tests, the number of recorded vibrations was divided by seventy-nine and the value rounded off to the third decimal place.

6. *The Electrical Circuit.*—The wiring

Table 2.—Time Required to Cast Gold Through 14-Gage (B&S) Sprues Under Pressures of 5, 10 and 20 Pounds per Square Inch

14-Gage (B&S) Sprues				
No.	Vibrations	Time (Seconds)	P_1-P_2 (1 Cm.) (Seconds)	Weight (Grains)
20 Lb./Sq. In.				
19	4.5	0.057	25	83
20	4.5	0.057	25	82
21	4.5	0.057	27	78
22	4.5	0.057	30	83
23	4.5	0.057	30	84
24	4.5	0.057	32	81
10 Lb./Sq. In.				
25	5.5	0.069	75	80
26	5.5	0.069	78	83
27	6.0	0.076	77	79
28	5.5	0.069	72	78
29	6.0	0.076	72	83
30	5.5	0.069	75	80
5 Lb./Sq. In.				
31	10.0	0.126	94	82
32	9.0	0.114	88	83
33	9.5	0.120	95	80
34	9.0	0.114	85	79
35	10.0	0.126	100	80
36	9.0	0.114	85	80

diagram of the break and make circuit in relation to the various units of equipment is diagrammatically represented in Figure 2.

PROCEDURE

The storage tank was filled with air from a supply line and the reducer set to maintain the desired pressure. A prepared flask was removed from the electric furnace and placed on the casting machine. The terminal clamps of the electric circuit were then attached to the platinum-iridium wires projecting from each side of the flask. A specified amount of casting gold,* which had been previously heated to redness on a charcoal block, was placed in the crucible. The metal was immediately brought to the proper casting temperature by means of an oxygen and gas blowpipe. Just prior to the depressing of the handle of the machine, the switch on the backboard was closed, this completing the electrical circuit and causing the writing point of the signal magnet to move up. At the same instant, the tuning-fork was energized and the motor of the kymograph turned on; which caused the drum to revolve. The handle of the casting machine was quickly depressed, and the sealing cap thus brought into contact with the rim of the flask and air pressure admitted to the crucible, effecting the entry of the molten metal into the mold. Simultaneously with the admission of air pressure, the circuit breaker was actuated, the circuit being broken and the writing point of the signal magnet allowed to drop.

The filling of the pattern chamber with molten metal effected contact between the two platinum-iridium wires embedded in the mold and the circuit was again completed, the writing point of the signal magnet then moving up. The time interval was determined by counting the number of vibrations and dividing this value by the frequency of the tuning-fork.

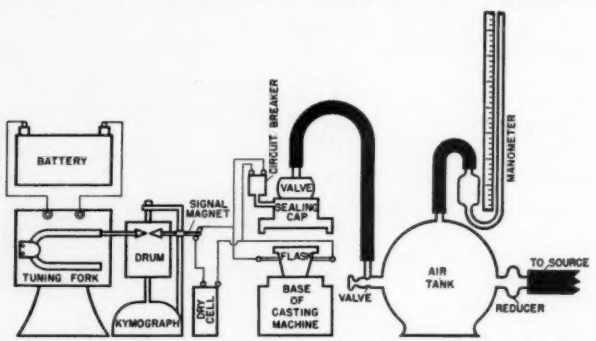

Fig. 2.—Diagrammatic representation (not to scale) of apparatus, including wiring diagram of break and make circuit.

The final value established for each determination was derived from the average of several tests. The variation in each series of measurements is expressed by the formula: Standard deviation =

$$\pm \sqrt{\frac{\text{sum of squares of deviations from mean}}{\text{total number of observations}}}$$

*The gold alloy used throughout the course of the investigation was an American Dental Association specification type with the following approximate formula: gold, 90 per cent; copper, 7 per cent; platinum, 1 per cent, and silver, 2 per cent. Five pennyweight was used in each test with the exception of the series in Table 13, where the volume of the pattern was increased to 0.6 cc. In these tests, 10 dwt. was used.

These standard deviation values are given in the summary tables.

PRELIMINARY EXPERIMENTS WITH MERCURY

To save time in working out the details of the experiments, preliminary tests were made by casting mercury in "cold" molds. This allowed repeated observations to be made with the same mold.

Table 3.—Time Required to Cast Gold Through 17-Gage (B&S) Sprues Under Pressures of 5, 10 and 20 Pounds per Square Inch

17-Gage (B&S) Sprues				
No.	Vibrations	Time (Seconds)	P_1-P_2 (1 Cm.) (Seconds)	Weight (Grains)
20 Lb./Sq. In.				
37	8.5	0.107	38	80
38	8.5	0.107	38	77
39	8.5	0.107	40	79
40	9.0	0.114	31	81
41	8.5	0.107	41	80
42	9.0	0.114	36	80
10 Lb./Sq. In.				
43	12.0	0.152	93	80
44	12.5	0.158	95	83
45	12.0	0.152	90	80
46	12.0	0.152	98	81
47	12.0	0.152	85	81
48	12.0	0.152	99	78
5 Lb./Sq. In.				
49	17.5	0.221	80	81
50	22.5	0.285	85	80
51	19.5	0.247	83	83
52	22.0	0.278	77	78
53	19.0	0.240	78	81
54	20.0	0.253	78	80

While the results of hundreds of tests with mercury are not included in this report, they compared so favorably with the values later obtained with gold that we can recommend the procedure as a satisfactory and simplified means of studying casting time.

RESULTS OF EXPERIMENTS WITH GOLD

1. *Effect of Pressure and Gage of Sprues.*—The first series of fifty-four experiments were performed in an effort to measure the time required to cast gold through round sprues of varying gages under varying degrees of pressure. The results are given in Tables 1, 2 and 3, and are summarized in Table 4.

The patterns were carved from inlay wax to the form of right cylinders measuring 6.4 mm. in diameter and 10 mm. in height. A contact tip was attached to each pattern in the manner previously described.

The sprue formers were round metal pins, the gages of which were checked with a micrometer caliper. In each case, the pin was attached to the center of the circular base of the pattern and adjusted in position on the crucible former to provide a sprue 8 mm. in length. Sprue

formers of 11, 14 and 17 gage (B&S)* were selected because the extremes do not exceed the range that is consistent with accepted casting practice and the cross-sectional areas of those respective gages progressively decrease by 50 per cent.

Likewise, pressures of 20, 10 and 5 pounds per square inch were selected for the same reasons. The cross-sectional dimensions of the sprues in square millimeters are given in Table 4.

It is, of course, evident that the stated values for the cross-sectional areas of the sprues are slightly in error owing to discrepancies due to the removal of the pins and dimensional changes of the investment material during heating and cooling. No attempt was made to avoid this discrepancy since it was believed that an approximate measure of the time required to cast gold under customary conditions would be of greater practical value than a more accurate measure under abnormal conditions.

In this series of tests, air from the large storage tank was admitted directly to the valve of the casting machine without passing through the small tank in the base of the machine. This was done to insure a sustained pressure during the casting operation. Realizing that some leakage of air in pressure casting is likely to occur through the asbestos packing in the sealing cap, or between the asbestos and the rim of the flask, or between the investment material and the flask or through the investment material, it was thought advisable to make some measurement of this decrease in pressure. This was done by recording, with a stop watch, the time interval between the application of air pressure to the crucible and a drop of the mercury column in the manometer to a point 1 cm. below the indicated pressure used in making the casting. This distance represents a decrease in pressure of 0.2 pound per square inch. The time required to produce this loss of pressure (P_1-P_2) during each casting operation was measured in seconds. The values are given in Tables 1, 2 and 3. It will be ob-

TABLE 4.—SUMMARY OF RESULTS OF EXPERIMENTS TO DETERMINE TIME REQUIRED TO CAST GOLD THROUGH 11, 14 AND 17 GAGE (B&S) SPRUES UNDER PRESSURES OF 5, 10 AND 20 POUNDS PER SQUARE INCH

Sprue		Pressure (Lb./In.²)	Number of Measurements	Average Time (Seconds)	Standard Deviation (Seconds)
Gage (B&S)	Cross-Sectional Area (MM^2)				
11	4.0	20	6	0.030	±0.0035
11	4.0	10	6	0.040	±0.0028
11	4.0	5	6	0.064	±0.0023
14	2.0	20	6	0.057	±0.0000
14	2.0	10	6	0.071	±0.0034
14	2.0	5	6	0.119	±0.0050
17	1.0	20	6	0.108	±0.0036
17	1.0	10	6	0.153	±0.0023
17	1.0	5	6	0.254	±0.0043

Pattern, right cylinder (D. 6.4 mm. × H. 10 mm.)
Length of sprue, 8 mm.
Mold temperature, 650°C.
Temperature of casting gold kept as nearly constant as possible.

*The gage numbers used throughout this paper refer to Brown and Sharpe or American Standard Wire Gages.

served from a study of the data that the greatest leakage of air occurred when the highest pressure was used, but in no single series of tests can any correlation be made between the amount of leakage and the time required to produce the casting. It should also be pointed out that certain irregularities in the recorded values for the drop in pressure may have been due to a slight leakage of air through the circuit breaker, either during or just before the seating of the rubber washer. This, unquestionably, accounts for the low values in the tests with 5 pounds, since the pressure was insufficient to effectively seat the washer.

The weights given in the tables are of the castings proper after the excess metal filling the sprues and contact tips was removed. The castings averaged 3 dwt. and 8 grains each and the total variation in the weights amounted to only 8 grains.

The average values for the time required to cast gold through 11-, 14- and 17-gage sprues under pressures of 5, 10 and 20 pounds per square inch are represented graphically in Figures 8 and 9. Referring to these graphs, it may be observed that the time with sprues of all gages is appreciably increased when the pressure is reduced to 5 pounds and that the time with pressures of varying degrees is appreciably increased when the size of the sprue is reduced to 17 gage. Differences in time when the pressure is varied between 10 and 20 pounds is not so marked, especially with 11 and 14 gage sprues. It may also be noted that 5 pounds of pressure with an 11-gage sprue is more effective than 10 pounds with a 14-gage sprue. Likewise, 10 pounds with 11-gage is more effective than 20 pounds with 14-gage.

These graphs show that the cross-sectional area of the sprue has a greater influence on casting time than does the degree of pressure. For practical purposes, it may be stated that the time with varying degrees of pressure is inversely proportional to the square of the diameter of the sprue. In other words, when the

TABLE 5.—RESULTS OF DECREASING TANK CAPACITY AND INDUCING LEAKAGE OF AIR, ON TIME REQUIRED TO CAST GOLD UNDER PRESSURE

No.	Vibrations	Time (Seconds)	P_1-P_2 (1 Cm.)* (Seconds)	No.	Vibrations	Time (Seconds)	P_1-P_2 (25.8 Cm.)† (Seconds)
1	5.5	0.069	2	11	6.	0.076	68
2	6.0	0.076	1	12	5.5	0.069	54
3	5.5	0.069	2	13	5.5	0.069	62
4	5.5	0.069	1				
5	5.5	0.069	2		Induced Leakage		
6	6.5	0.082	2				
7	6.0	0.076	2	14	10.	0.126	12
8	5.0	0.063	1	15	7.5	0.095	12
9	6.5	0.082	2	16	7.	0.088	25
10	5.5	0.069	1	17	8.	0.101	32
				18	8.	0.101	21
Average 0.072				Nos. 14-18 average 0.102			

*1 cm. = 0.2 lb. per sq. in.
†25.8 cm. = 5 lb. per sq. in.
Pattern, right cylinder (D. 6.4 mm. × H. 10 mm.)
Gage of sprue, 14 (B&S); length, 8 mm.
Mold temperature, 650°C.
Pressure, 10 lb. per sq. in.

cross-sectional area of the sprue is doubled, the time is cut in half.

For most efficient results in pressure casting, we strongly recommend the avoidance of sprues of smaller gages than 14 and pressures of less than 10 pounds.

Of course, limitations are placed on the magnitude of the cross-sectional area of the sprue by the danger of the premature entrance of the metal into the mold. In the tests with 11-gage sprues, an occasional accident of this nature occurred and, for this reason, it is advised that the size of round sprues be limited to 12-gage whenever as much as 5 dwt. of gold is melted over the hole.

As far as pressure is concerned, the

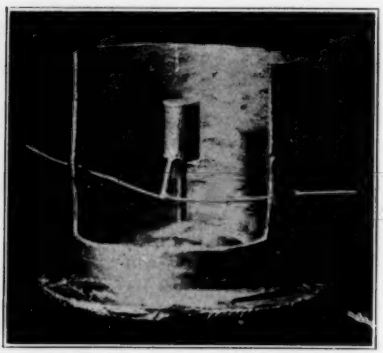

Fig. 3.—Prepared pattern ready for investing. The flask is sectioned to show the interior.

graphs show that little advantage is to be gained with more than 20 pounds and that the range between 10 and 20 pounds is quite satisfactory. It should be pointed out that with low pressures an apparently complete casting may be produced which, on close examination, shows the failure of the metal to copy the fine details of the pattern chamber.

2. *Effect of Leakage.*—The series of tests just described was made with sustained pressure from a storage tank of 20 gallons (4,620 cubic inches) capacity. Since most casting machines are equipped with pressure tanks of relatively small capacity, it was thought advisable to study the effect of a more rapid loss of pressure, associated with the use of these devices, on casting time. It was necessary to make slight mechanical alterations in the casting machine in order to utilize the small tank of one-fourth gallon capacity (58 cubic inches) enclosed in the base of the machine.

A series of ten tests was made through 14-gage sprues, 8 mm. in length, under 10 pounds pressure. The time required for the mercury column to drop 1 cm. was recorded with a stopwatch. The results of these tests are given in Table 5 (Nos. 1-10). Except for a reduction in the capacity of the air storage tank, all

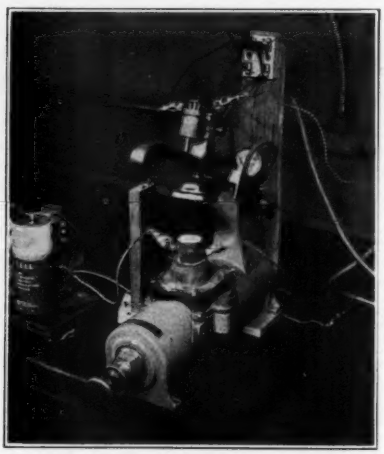

Fig. 4.—Casting machine. A prepared flask with terminal clamps attached to the projecting wires is shown in position on the table. The circuit breaker may be seen above the handle of the machine.

conditions were identical with those of the tests reported in Table 2 (Nos. 25-30).

We observe that the average casting time with pressure from the large tank is identical with that required in using the small tank, while the average leakage index (P_1-P_2) with the large tank was 78 seconds and with the small tank was 1.6 seconds. It may be concluded, therefore,

that the relatively rapid loss of pressure in a small storage tank has no effect on casting time. The loss of pressure measured in these tests may be regarded as normal leakage. It occurred under ideal conditions with respect to the mechanical perfection of the machine, casting flasks and asbestos sealing pad.

Since these conditions, through carelessness, are not always maintained at such a high degree of perfection in practice, it was thought advisable to consider the effect of induced leakage on casting time. In order to effect this leakage, three small pieces of sheet metal were placed on the rims of the flasks. These metal pieces were of sufficient thickness to make the escape of air between the flask and the asbestos pad plainly audible.

During the first test, it was observed that the fall of the manometer was too rapid to permit measurement of an interval of 1 cm. The interval was arbitrarily increased to 25.8 cm., which is equivalent to a fall in pressure of 5 pounds per square inch. Since the previous tests were made with a fall of only 0.2 pound, it was necessary to check this new interval without inducing leakage in order to establish a means of comparison. The results of these measurements (Table 5, Nos. 11-13) show an average leakage index (P_1-P_2) of 61 seconds. Five tests were then made with induced leakage. (Table 5, Nos. 14-18.) The average time required to produce these castings was 0.102 second, accompanied by an average leakage index (P_1-P_2) of 20 seconds.

In several instances, during these experiments, the magnitude of the leakage was sufficient to produce incomplete castings. Obviously, in these cases, no measurement of the casting time was permitted. From a study of these data, it may be concluded that the so-called normal leakage of air pressure has no effect on casting time and that considerable leakage has no marked effect as long as the pressure is sufficient to complete the casting.

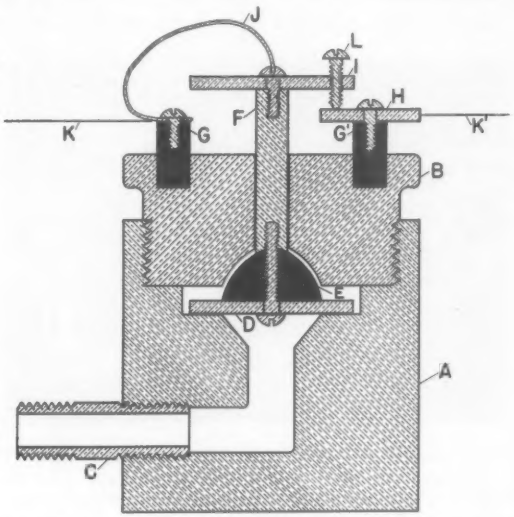

Fig. 5.—Cross-sectional details of air circuit-breaker. The device, measuring 1 inch in diameter and 2 inches in height, was attached to the casting machine by means of the nipple C.

This conclusion should not be interpreted, however, as encouragement to disregard the conditions of the flask rim

and the asbestos sealing pad, for failures in casting resulting from these defects are numerous. At the same time, there is a prevailing tendency to attribute the cause of incomplete casting to leakage of the machine when the true cause is failure to heat the metal sufficiently to keep it molten long enough to allow the filling of all recesses of the pattern chamber.

3. *Effect of Mold Temperature.*—A series of ten experiments was performed to determine what effect the temperature of the mold might have on casting time. The results are given in Table 6. In the first series of tests (Nos. 1-5), the molds were heated to a temperature of 540°C. (1004°F.). The average time required to fill the pattern chamber with gold was 0.070 second. In the second series (Nos. 6-10), the molds were heated to a temperature of 815°C. (1499°F.) and the measurements resulted in an average casting time of 0.070 second. All other conditions were kept constant and were identical with those of previous tests.

It may be readily concluded that differences in the temperature of the molds of approximately 300°C. (500°F.) have no effect on casting time. It must be remembered, however, that with higher mold temperatures, the gold will remain molten for a longer time. Consequently, the tendency for premature freezing of the metal is reduced. The data recorded in the table on the age of the molds will be discussed later.

4. *Effect of Temperature of Casting Gold.*—Surface tension is an important property of molten metals with respect to their castability. While it is known that surface tension decreases with increased temperature, there is no evidence, to our knowledge, that variations in the measure of this property of molten metals between the fusing point and the suitable casting temperature has any influence on the speed with which metal is cast. Desiring to measure the effect of varying the temperature of the metal on casting time and realizing the difficulty of setting up equipment to make accurate temperature measurements, we decided to first test the effects of extreme conditions. Accordingly, five tests were made with the casting gold "just fused" and five tests were made with the metal "white hot." The former condition of the metal represents the lowest temperature at which a casting could be made; the latter condition, an approach to the maximum temperature obtainable with an oxygen and gas blowpipe. All other conditions were

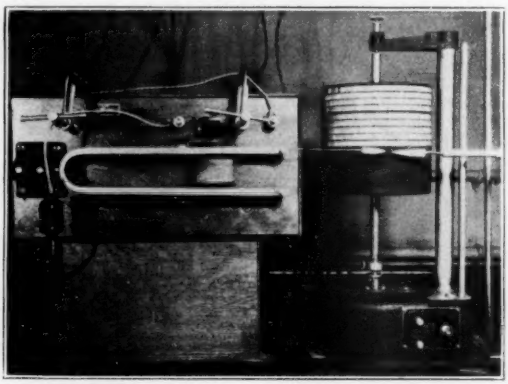

Fig. 6.—Equipment for making time-interval measurements. The electrically operated tuning-fork is shown on the left and the motor kymograph on the right. The two writing points in front of the smoked drum are attached to the tuning-fork and signal magnet, respectively.

kept constant and were identical with those described in previous experiments.

From the findings of these tests, it was concluded that further measurements under controlled temperature conditions were unnecessary. A comparison of the results given in Table 7 shows that the temperature of the casting gold within wide limits has no effect on the time required to fill pattern chambers.

It is not to be inferred, however, that these variations in temperature are of no importance in successful casting practice. Overheating may detrimentally affect the physical properties of the casting gold, and underheating may result in the failure of the metal to stay molten sufficiently long to complete the casting. Incidentally, it is our belief that more failures in casting are caused by underheating the metal than by overheating it.

5. *Effect of Age of Molds.*—During the tests reported in Tables 6 and 7, the age of the molds were recorded. These notations represent the time interval between the mixing of the investment

TABLE 6.—RESULTS OF VARYING MOLD TEMPERATURE ON TIME REQUIRED TO CAST GOLD UNDER PRESSURE

Mold Temperature 540°C. (1004°F.)				Mold Temperature 815°C. (1499°F.)			
No.	Vibrations	Time (Seconds)	Age of Mold (Hours)	No.	Vibrations	Time (Seconds)	Age of Mold (Hours)
1	5.5	0.069	1½	6	5.5	0.069	¼
2	5.5	0.069	½	7	6.0	0.076	1½
3	5.5	0.069	18	8	5.5	0.069	22
4	6.0	0.076	¼	9	5.5	0.069	18
5	5.5	0.069	28	10	5.5	0.069	28
Average 0.070				Average 0.070			

Pattern, right cylinder (D. 6.4 mm. × H. 10 mm.)
Gage of sprue, 14 (B&S); length, 8 mm.
Pressure, 10 lb. per sq. in.

TABLE 7.—RESULTS OF VARYING TEMPERATURE OF METAL ON TIME REQUIRED TO CAST GOLD UNDER PRESSURE

Temperature of Casting Gold							
Just Fused				White Hot			
No.	Vibrations	Time (Seconds)	Age of Mold (Hours)	No.	Vibrations	Time (Seconds)	Age of Mold (Hours)
1	5.5	0.069	¼	6	5.5	0.069	¼
2	5.5	0.069	½	7	5.0	0.063	28
3	6.0	0.076	¼	8	5.5	0.069	18
4	5.5	0.069	28	9	6.0	0.076	½
5	5.5	0.069	18	10	6.0	0.076	28
Average 0.070				Average 0.071			

Pattern, right cylinder (D. 64 mm. × H. 10 mm.)
Gage of sprue, 14 (B&S); length, 8 mm.
Pressure, 10 lb. per sq. in.

material and the placing of the flasks in the electric furnace. This study was made with the thought that the age of the molds might have some influence on the permeability of the investment material and, in turn, affect the casting time. Since no means has been devised for measuring permeability at high temperatures, a study of this possible correlation seemed justified. Results of the tests, however, failed to furnish any evidence of such a relationship. Other conditions in each of the four series of tests remained constant.

6. *Effect of Use of "New" Gold.*—The repeated melting and casting of a given mass of gold alloy appears to produce a condition of sluggishness which is not observed when the alloy is melted for the first time. Since it was believed that this state of the alloy might have a bearing on the casting time and was noted that the tests reported in Tables 6 and 7 were made with casting gold which had been remelted numerous times, a series of measurements with new metal was made to determine any differences in casting time. The results given in Table 8 show an average measurement of 0.070 second, which is identical with those of the previous tests in which remelted casting gold was used.

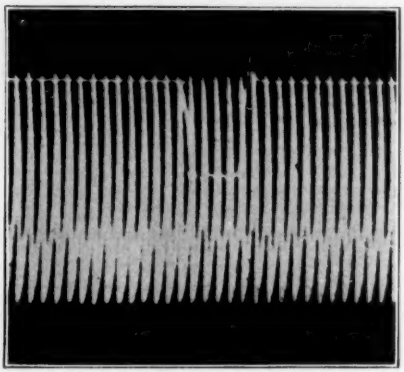

Fig. 7.—Typical tracing, enlarged. The actual tracings were small enough to require the aid of a small lens for accurate counting. The interim of this recording is 4.5 vibrations, or 0.057 second.

It should be remembered, however, that the contamination and unbalancing of gold alloys by improper heating and recasting may seriously impair the quality of appliances fabricated from them. One is justified in the repeated casting of a given mass of gold alloy only when extreme care with respect to cleanliness and blowpipe technic is exercised.

7. *Effect of Length of Sprue.*—It has been generally conceded that the frictional resistance between the walls of the sprue and the molten metal during casting is sufficient to justify the demand that sprues be kept as short as possible. In an effort to establish or refute this contention, two series of five tests each were made with round 14-gage sprues, 2 mm. and 25 mm. in length, respectively. The patterns were of the same dimensions as those used in previous tests and the castings were made with 10 pounds of pressure.

The results, given in Table 9, were surprising indeed, since no essential difference was observed in the time required to cast through sprues of widely varying

TABLE 8.—RESULTS OF USE OF NEW* METAL ON TIME REQUIRED TO CAST GOLD UNDER PRESSURE

No.	Vibrations	Time (Seconds)
1	6.0	0.076
2	5.5	0.069
3	5.5	0.069
4	5.5	0.069
5	5.5	0.069
	Average	0.070

Pattern, right cylinder (D. 6.4 mm. × H. 10 mm.)

Gage of sprue, 14 (B&S); length, 8 mm.

Pressure, 10 lb. per sq. in.

*The term "new" is used here to mean that the alloy has been melted for the first time, in contradistinction to the term "old," which denotes its state after it has been recast many times.

lengths. The results are also identical with those of previous tests wherein 8 mm. sprues were used.

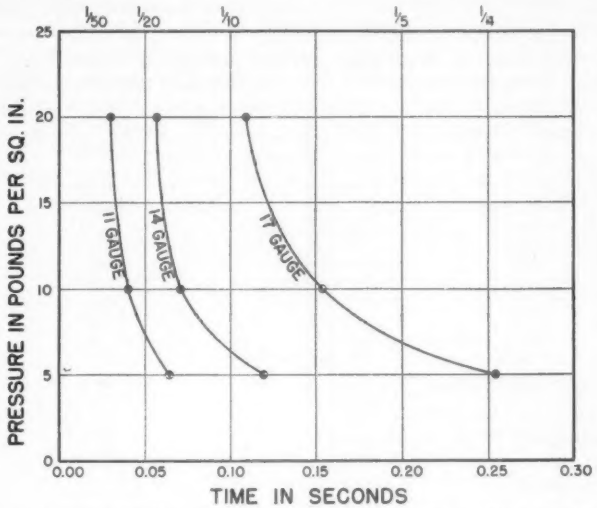

Fig. 8.—Graphic representation of effect of varying pressure on time required to cast gold through sprues of varying gages.

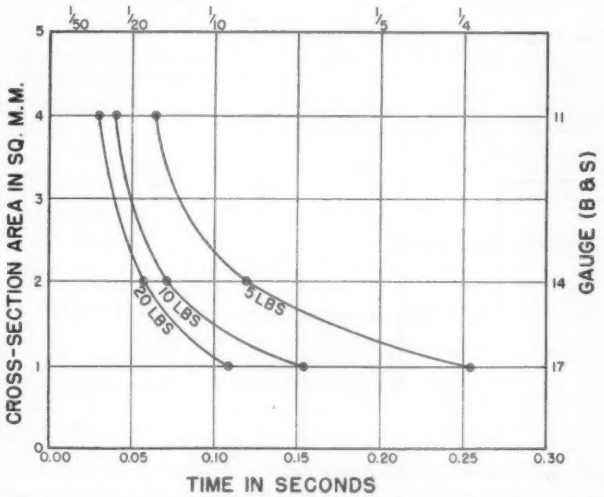

Fig. 9.—Graphic representation of effect of varying cross-sectional area of sprue on time required to cast gold under varying degrees of pressure.

It may well be that when the molten metal reaches the end of the longer sprue, the kinetic pressure head is increased and, correspondingly, there is an increase in the velocity of flow which causes the pattern chamber to fill more rapidly. The increased rapidity with which the pattern chamber fills may offset the increase in time required to move the metal through

the longer sprue; hence, the total time involved is no greater than that required to cast the same volume of metal through a shorter sprue.

stated limits, they are: (1) temperature of molds; (2) temperature of casting gold; (3) age of molds; (4) use of new or remelted casting gold; (5) capacity of

TABLE 9.—RESULTS OF VARYING LENGTH OF SPRUE ON TIME REQUIRED TO CAST GOLD UNDER PRESSURE

Length of Sprue 2 Mm.			Length of Sprue 25 Mm.		
No.	Vibrations	Time (Seconds)	No.	Vibrations	Time (Seconds)
1	6.0	0.076	6	6.0	0.076
2	5.0	0.063	7	5.5	0.069
3	5.5	0.069	8	6.0	0.076
4	5.5	0.069	9	5.5	0.069
5	6.0	0.076	10	6.0	0.076
Average 0.071			Average 0.073		

Pattern, right cylinder (D. 6.4 mm. × H. 10 mm.)
Gage of sprue, 14 (B&S)
Pressure, 10 lb. per sq. in.

TABLE 10.—SUMMARY OF RESULTS OF VARYING CONDITIONS WHICH EFFECT NO APPRECIABLE CHANGE IN TIME REQUIRED TO CAST GOLD UNDER PRESSURE*

Mold Temperature (°C.)	Temperature of Casting Gold	New or Remelted Casting Gold	Capacity of Air-Storage Tank (Gal.)	Length of Sprue (Mm.)	Number of Measurements	Average Time (Seconds)	Standard Deviation (Seconds)
540	Moderate	Remelted	20	8	5	0.070	±0.0028
815	Moderate	Remelted	20	8	5	0.070	±0.0028
650	Just fused	Remelted	20	8	5	0.070	±0.0028
650	White hot	Remelted	20	8	5	0.071	±0.0050
650	Moderate	New	20	8	5	0 070	±0.0028
650	Moderate	Variable	¼	8	10	0.072	±0.0060
650	Moderate	Variable	20	2	5	0.071	±0.0050
650	Moderate	Variable	20	25	5	0.073	±0.0034

*Conditions for comparison are in outlined squares.

8. *Summary of Results of Conditions Not Affecting Casting Time.*—The results of varying conditions which effect no appreciable change in casting time are summarized in Table 10. Within the

air storage tank, and (6) length of sprue.

Consideration will now be given to certain conditions which do effect a change in casting time.

9. *Effect of Multiple Sprues.*—In or-

der to determine the extent to which the use of multiple sprues will reduce the time required to cast gold, two series of tests, five in each, were made with two and three sprues, respectively. The results are given in Table 11. Remembering that, in previous tests, the time required to fill a pattern chamber of the same volume through one 14-gage sprue was approximately 0.071 second, it will be observed that with two 14-gage sprues, the time is reduced 50 per cent, and with three 14-gage sprues, it is reduced 63 per cent. From a study of these results, it may be stated that, for practical purposes, the time required to cast gold through one, two and three sprues is inversely proportional to the number of sprues.

It will be recalled that in the tests with sprues of varying cross-sectional areas, the time was inversely proportional to the square of the diameter of the sprue. The analogy between these two suggested laws offers proof of the fact that, under customary casting conditions, the effect of friction between the molten metal and the sprue is negligible.

It is interesting to note from the sum-

TABLE 11.—RESULTS OF USE OF MULTIPLE SPRUES ON TIME REQUIRED TO CAST GOLD UNDER PRESSURE

Two 14-Gage (B&S) Sprues			Three 14-Gage (B&S) Sprues		
No.	Vibrations	Time (Seconds)	No.	Vibrations	Time (Seconds)
1	2.5	0.032	6	2.0	0.025
2	3.0	0.038	7	2.0	0.025
3	3.0	0.038	8	2.5	0.032
4	2.5	0.032	9	2.0	0.025
5	3.0	0.038	10	2.0	0.025
Average 0.036			Average 0.026		

Pattern, right cylinder (D. 6.4 mm. × H. 10 mm.)
Pressure, 10 lb. per sq. in.

TABLE 12.—RESULTS OF USE OF SQUARE AND RECTANGULAR SPRUES ON TIME REQUIRED TO CAST GOLD UNDER PRESSURE

Square Sprue* (1.4 × 1.4 Mm.)			Rectangular Sprue† (1.15 × 5 Mm.)		
No.	Vibrations	Time (Seconds)	No.	Vibrations	Time (Seconds)
1	6.5	0.082	6	3.0	0.038
2	6.0	0.076	7	3.5	0.044
3	7.0	0.088	8	3.0	0.038
4	6.5	0.082	9	2.5	0.032
5	6.5	0.082	10	3.0	0.038
Average 0.082			Average 0.038		

*Equivalent in cross-sectional area to one 14-gage (B&S) sprue.
†Equivalent in cross-sectional area to three 14-gage (B&S) sprues.
Pattern, right cylinder (D. 6.4 mm. × H. 10 mm.)
Pressure, 10 lb. per sq. in.

mary of these results (Table 14) that an 11-gage sprue having a cross-sectional area of 4 sq. mm. and a circumference of 7.22 mm. gave an average casting time of 0.040 second, while two 14-gage sprues having the same cross-sectional area, but a total perimeter of 10.04 mm., gave an average casting time of 0.036. This difference in casting time is not significant from a practical standpoint, but emphasizes the absence of the effect of friction by virtue of the increased perimeter.

10. *Effect of Square and Rectangular Sprues.*—In order to study the effect of the shape of the sprue on casting time, two series of five tests each were performed. For one series of tests, a square metal sprue-former was accurately machined to measure 1.4 mm. by 1.4 mm., the cross-sectional area of which is equivalent to that of one 14-gage sprue. For the other series of tests, a rectangular metal sprue former was similarly prepared, to measure 1.15 mm. by 5 mm., the cross-sectional area of which is equivalent to that of three 14-gage sprues.

The results of these tests are given in Table 12 and the values may be compared with those obtained from the tests with round sprues in Table 14. It will be observed that the average time required to cast gold through the square sprue was 0.082 second as compared with 0.071 second for a round sprue of the same cross-sectional area. Moreover, the average time required to cast gold through the rectangular sprue was 0.038 second as compared with 0.026 second for three round sprues having an equivalent cross-sectional area.

The increase in time with both the square and the rectangular sprues cannot be explained, as has been previously pointed out, by friction due to differences in the perimeters, but is probably a result of the failure of the molten metal during its passage through the sprue to fill out the corners, the effect of which was the same as if a sprue of smaller dimensions had been used.

Table 13.—Results of Varying Volume of Pattern Chamber on Time Required to Cast Gold Under Pressure

Volume of Pattern Chamber 0.15 Cc.*				Volume of Pattern Chamber 0.6 Cc.†			
No.	Vibrations	Time (Seconds)	Weight (Grains)	No.	Vibrations	Time (Seconds)	Weight (Grains)
1	2.5	0.032	41	6	11.5	0.145	168
2	3.0	0.038	43	7	11.0	0.139	165
3	3.0	0.038	42	8	11.5	0.145	167
4	2.5	0.032	42	9	11.5	0.145	167
5	3.0	0.038	42	10	11.5	0.145	168
Average 0.036				Average 0.144			

*Pattern, right cylinder (D. 6.4 mm. × H. 5 mm.)
†Pattern, right cylinder (D. 6.4 mm. × H. 20 mm.)
Gage of sprue, 14 (B&S)
Pressure, 10 lb. per sq. in.

11. *Effect of Volume of Pattern Chamber.*—In all the tests reported up to this time, the dimensions of the patterns were kept constant at 6.4 mm. in diameter and 10 mm. in height. The time required to fill a pattern chamber of this volume (0.3 cc.) through a 14-gage sprue under 10 pounds of pressure was 0.071 second.

In order to measure the effect of varying the volume of the pattern chamber on casting time, two series of experiments

were performed. In the first series, five castings were made, with patterns 6.4 mm. in diameter and 5 mm. in height. The average time required to fill the pattern chamber (0.15 cc.) was 0.036 second. In the second series, five castings were made using patterns 6.4 mm. in diameter and 20 mm. in height (0.6 cc.). The average casting time was 0.144 second.

These results (Table 13) show that for variations between 0.15 and 0.6 cc., the time is directly proportional to the volume of the pattern chamber. The weights of the castings are also given in Table 13.

12. ***Summary of Results of Conditions Affecting Casting Time.***—The results of varying conditions which effect a change in casting time are summarized in Tables 4 and 14. They are as follows: (1) cross-sectional area of sprue; (2) amount of pressure; (3) volume of pattern chamber; (4) number of sprues, and (5) shape of sprue.

13. ***Effect of the Time Required to Close the Casting Machine.***—Under customary conditions of pressure casting, the blowpipe flame is removed from the molten metal simultaneously with the depression of the handle of the casting machine. Since cooling of the molten metal begins at the instant that the blowpipe flame is removed, it seemed important to measure the interim between the removal

TABLE 14.—SUMMARY OF RESULTS OF VARYING CONDITIONS, OTHER THAN PRESSURE, ON TIME REQUIRED TO CAST GOLD UNDER PRESSURE*

No.	Sprue				Volume of Pattern Chamber (Cc.)	Number of Measurements	Average Time (Seconds)	Standard Deviation (Seconds)
	Shape	Dimensions	Total Cross-Sectional Area ($Mm.^2$)	Perimeter (Mm.)				
1	Round	11 gage	4.0	7.22	0.3	6	0.040	±0.0028
1	Round	14 gage	2.0	5.02	0.3	6	0.071	±0.0034
1	Round	17 gage	1.0	3.45	0.3	6	0.153	±0.0023
1	Round	14 gage	2.0	5.02	0.3	6	0.071	±0.0034
1	Square	1.4×1.4 mm.	2.0	5.60	0.3	5	0.082	±0.0053
1	Round	14 gage	2.0	5.02	0.3	6	0.071	±0.0034
2	Round	14 gage	4.0	10.04	0.3	5	0.036	±0.0030
3	Round	14 gage	6.0	15.06	0.3	5	0.026	±0.0028
3	Round	14 gage	6.0	15.06	0.3	5	0.026	±0.0028
1	Rectangle	1.15×5 mm.	6.0	12.30	0.3	5	0.038	±0.0038
1	Round	14 gage	2.0	5.02	0.15	5	0.036	±0.0030
1	Round	14 gage	2.0	5.02	0.30	6	0.071	±0.0034
1	Round	14 gage	2.0	5.02	0.60	5	0.144	±0.0024

*Conditions for comparison are in outlined squares.

of the flame and the application of air pressure to the crucible.

A slight modification was made in the mechanical design of the casting equipment to permit a recording of this measurement. The upright post, shown to the left of the machine in Figure 4, supported a flexible wire which was allowed to contact an extension on the handle of the machine in its downward movement. This contact, which was maintained during the casting operation, together with the action of the air circuit-breaker, provided the necessary means for measuring the interim.

TABLE 15.—RESULTS OF TESTS TO MEASURE INTERIM BETWEEN BEGINNING OF DEPRESSION OF HANDLE OF CASTING MACHINE AND APPLICATION OF AIR PRESSURE TO CRUCIBLE*

No.	Vibrations	Time (Seconds)
1	28.0	0.354
2	28.0	0.354
3	25.0	0.316
4	28.5	0.360
5	29.0	0.367
6	26.0	0.329
7	27.5	0.348
8	26.0	0.329
9	26.0	0.329
10	27.5	0.348
	Average 0.343	

*At the beginning of the interim, the flame was removed from the casting gold.

The tests were made during the act of casting by depressing the handle of the machine in the usual way. The results given in Table 15 show an average time of 0.343 second. The magnitude of this value is significant when it is compared with the actual time required to cast metal under widely varying conditions. It may be concluded, therefore, that considerably more time is lost, after removal of the flame, in closing the machine than is expended in forcing the metal into the mold. This fact attaches considerable importance to the deliberateness with which pressure machines are closed during the casting operation.

CONCLUSIONS

1. The cross-sectional area of the sprue has a greater influence on casting time than does the degree of pressure. For practical purposes and within limits, it may be stated that the time is inversely proportional to the square of the diameter of the sprue. In other words, when the cross-sectional area of the sprue is double, the time is cut in half.

2. For most efficient results in pressure casting, round sprues of smaller gages than 14 (B&S) and pressures of less than 10 pounds per square inch should be avoided.

3. No round sprue of larger cross-sectional area than 12 gage (B&S) should be used whenever as much as 5 dwt. of gold is melted over the hole, because of the danger of premature entrance of the metal in the mold.

4. Little advantage is to be gained with pressures in excess of 20 pounds per square inch, and the range between 10 and 20 pounds is quite satisfactory for all casting operations.

5. The relatively rapid loss of pressure in the small storage tanks incorporated in pressure casting machines has no effect on casting time; neither does the normal leakage of air pressure through the asbestos pad, or between the pad and the flask rim, or between the flask rim and the investment material, or through the investment material.

6. Considerable leakage of air pressure, by virtue of a defective seal between the asbestos pad and the flask rim, has no marked effect on casting time as long as the pressure is sufficient to complete the casting.

7. Differences in the temperature of the molds between 540°C. (1004°F.) and 815°C. (1499°F.) have no effect on casting time, but it should be remembered that, with higher mold temperatures, the metal will remain molten for a longer

time. Consequently, the tendency for premature freezing of the metal is reduced.

8. Variations in the temperature of the casting gold within wide limits have no effect on casting time, but overheating may detrimentally affect the physical properties of the alloy, and underheating may result in the failure of the metal to stay molten sufficiently long to complete the casting.

9. Varying the age of the molds (time interval between mixing and burn-out) from fifteen minutes to twenty-eight hours has no effect on casting time.

10. No differences were observed in the time required to cast "new" gold which had been melted for the first time and "old" gold which had been remelted and recast numerous times. Nevertheless, contamination and unbalancing of gold alloys by improper heating and recasting may seriously impair the quality of appliances fabricated from them, and this procedure is justified only when extreme care with respect to cleanliness and blowpipe technic is exercised.

11. Varying the length of the sprue between 2 and 25 mm. has no effect on casting time. A possible explanation is the fact that even though greater frictional resistance between the sprue walls and the molten metal may be present in the longer sprue, there is also an increase in the kinetic pressure head which increases the velocity of flow and causes the pattern chamber to fill more rapidly.

12. The time required to cast gold through one sprue is reduced 50 per cent when two sprues are used and 63 per cent when three are used. For practical purposes and within limits, it may be stated that the time is inversely proportional to the number of sprues.

13. Under customary casting conditions, the effect of friction between the molten metal and the sprue is negligible.

14. The time required to cast gold through square and rectangular sprues is increased slightly over that required to cast with round sprues of equivalent cross-sectional areas. This is probably a result of the failure of the molten metal to fill out the corners during its passage through square and rectangular sprues.

15. When the volume of the pattern chamber is varied between 0.15 and 0.6 cc., a variation in weight of 1.75 and 7 dwt., the casting time is directly proportional to the volume of the pattern chamber.

16. Considerably more time is lost, after removal of the blowpipe flame from the gold, in closing the machine than is expended in forcing the metal into the pattern chamber. This fact attaches considerable importance to the deliberateness with which pressure machines are closed during the casting operation.

ADDENDUM

Work is already in progress to measure the time required to cast gold by centrifugal force. A report of this study will be ready for publication in the near future.

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RELATION OF NUTRITION TO DENTAL CARIES; A REVIEW OF RECENT FINDINGS

By L. M. Fleisch, D.D.S., Topeka, Kan.

An enormous amount of literature has accumulated on the etiology of dental caries. The various factors in this disease are of such nature that no generally accepted theory has evolved from the experimental and clinical data submitted. This state of affairs leaves much to be desired as far as a practical means for the prevention of dental caries is concerned. As the current medical literature contains many reports that definitely recognize a relationship between dietary deficiencies and certain degenerative diseases, it becomes more apparent that an early agreement among dental investigators would be desirable. It is with this thought that certain present misconceptions of the relation of nutrition to dental caries will be pointed out.

There is much evidence that refined carbohydrates, particularly white flour and white sugar, are important factors in the etiology of dental caries. Since refining processes remove necessary mineral salts and vitamin substances from the natural foods, it is evident that refined foods become harmful by reason of the absence of certain substances rather than because of substances they do contain. C. A. Elvehjem, of the University of Wisconsin, recently stated that vitamin B complex has ten different vitamins or factors and the end is not yet. This important vitamin is the one removed in the processing of white flour and white sugar, and, as I have previously pointed out,[1] it seems probable that a deficiency of one or more of its factors might be a primary etiologic factor in dental caries.

Boyd and Drain were among the first to report control of dental caries by nutritional means. They observed the arrest of dental caries in twenty-eight well controlled diabetic cases, in 82 per cent of which there was definitely progressive caries prior to the establishment of dietary control. The presence of salivary calculus deposits on the teeth of these children was almost universal, and they recurred rapidly after removal. The arrest of caries was not noted in children with any other disease or condition, and since it was not dependent on diabetes, it must have resulted from some factor in diabetic management. These authors summarize their findings by stating that an abundance of dairy products, fruits and vegetables, supplemented with cod-liver oil, insured a considerable supply of mineral salts and vitamins and a basic ash, and that this fact, together with an adequate and balanced ration, marks the essential difference between the diet of the children with arrested caries and that of those whose caries is progressive.[2]

This study was one in which controls were available and were not used. By this, I mean that the diets of the children with progressive dental caries should have been compared with those of the diabetic children. Instead, the diet of the diabetic children was presented as a complete, balanced and adequate diet in spite of the fact that these children had salivary calculus deposits on their teeth, which the authors say is unusual in children.

It is interesting to note that the latest report with which I am familiar, namely kodachrome transparencies projected by Dr. Brauer at a recent refresher course in children's dentistry, indicates that this diet still causes the formation of salivary calculus on the teeth of children; which indicates that these children do not have a normal metabolism or the nutritional factors are unbalanced.

Boyd and Drain[2] state that some factor in diabetic management caused the arrest of dental caries in these children. One of the first steps in the accepted practice of diabetic management is the control of the carbohydrate intake and this control is effected largely by the removal of white flour and white sugar products, as well as other refined carbohydrates, from the diet of the diabetic patient. It seems reasonable to suppose that Boyd and Drain followed this practice in treating these diabetic patients. Therefore, it would seem that the essential difference between the diet of the children with diabetes and those hospitalized for other diseases and conditions concerned refined carbohydrates, and that the restriction of these substances in the diabetic diets was an important factor in the arrest of the dental caries.

The caloric value of foodstuffs seems to be a factor in the amount of food eaten. The removal of refined carbohydrates from the diet as a rule automatically results in an increase in the quantity of other foods ingested. This is an important point, for, as I have repeatedly observed in clinical practice, the removal of refined carbohydrates from the diet causes the appetite for other foods to be increased, and while the total food ingested may have the same caloric values, the variety of food is greater and the total weight or bulk of food is increased.

An interesting study supporting the contention that refined foods become harmful by reason of the absence of certain substances rather than the presence of certain substances has been reported by Murray, who found the incidence of caries to be lower in those communities in which sugar is derived from chewing sugar cane or using crude sugar than in those in which the refined product is used. She determined the calcium and phosphorus content of each material and found that crude sugar juice contains the greatest amount of each element. However, she believes that the small amounts of calcium and phosphorus are too small to afford an explanation of the difference in the incidence of dental caries.[3]

According to Bogert, it takes 3 feet of sugar cane to make one standardized cube of sugar; hence, one would have to chew a great deal of cane before very much sugar would be ingested.[4] It seems reasonable to believe that cane does not predispose to dental caries, because of its vitamin B complex, calcium, phosphorus, iron and crude fiber content; while refined sugar is an important predisposing agent in the production of dental caries because it does not contain these substances. According to Simmonds, many references can be cited associating sweet foods with dental caries and showing that this correlation did not begin in the twentieth century.[5] Weinberger quotes the following from "A Treatise on the Teeth" by Tolver, published in 1752:

> All kinds of sweetmeats and sugar contribute very much to the destruction of the teeth, because their gluey juices stick to the teeth; besides, sugars are of an acid, penetrant and corrosive nature. Those who love sugar and use it much rarely have good teeth.[6]

This is an interesting observation, for all who like sugar do not necessarily use much of it, and, in questioning patients, we should ask "Do you eat very much candy, jelly and other forms of sugar?" and not "Do you like candy, jelly, etc.?"

Probably, the most active of contemporary workers endeavoring to correlate

the incidence of dental caries with the consumption of refined sugar have been Bunting and the University of Michigan group. This group has shown definitely that there is a relationship between the consumption of candy and the incidence of caries.[7] Koehne, Bunting and Morrell found that, by increasing the sugar intake in the form of candy, active dental caries can be induced in children on a diet that is nutritionally adequate.[8] When refined sugar in the form of candy was added to the adequate diet, the diet automatically became inadequate. The fact that all unrefined carbohydrates contain vitamin B complex, crude fiber, calcium, phosphorus, iron and, in most cases, copper should indicate that all these substances may be needed for the complete utilization of carbohydrates without disturbing normal metabolism. It is therefore probable that any diet containing refined carbohydrates is deficient in vitamin B complex, crude fiber, calcium, phosphorus, iron and copper in direct proportion to the amount of refined carbohydrates ingested.

In the same study, Koehne, Bunting and Morrell observed three children who failed to show a relationship between the use of a nutritionally adequate diet high in sugar and the progress of caries activity. They believe that these children may belong to the small group who are naturally immune to this disease and who remain so regardless of the character of the diet.[9] It would be interesting to know the condition of the soft tissues in the mouths of these immune children. It is a well-known clinical fact that individuals who are very susceptible to periodontal disease rarely have extensive dental caries, and many individuals who are very susceptible to dental caries are relatively immune to periodontal conditions. As some experimental animals synthesize vitamin substances, it is entirely possible that some persons may have a similar power, and this may explain the immunity of these children.

Hoppert, Webber and Canniff report the production of dental caries in the lower molars of rats fed a stock diet that caused excellent growth and skeletal development. The diet consisted of yellow corn 60 parts, whole milk powder 30, linseed meal 6, alfalfa meal 3 and sodium chloride 1 part. When the corn in this diet was replaced with oatmeal, no caries developed. It was obvious to them that the cornmeal played an important rôle in the production of caries. This belief was further strengthened by the fact that rats on various experimental diets containing cornmeal almost without exception showed signs of dental decay; whereas those on similar diets containing oatmeal gave no indication of caries. It was observed, moreover, that, with diets containing cornmeal, there was a tendency for particles of corn to lodge in the dental grooves, usually in the lower molars. This was followed by the development of small cavities, which encouraged impaction of food and subsequent extensive decay. It was found later that when finely ground corn was fed to the rats, no impaction of food was observed and consequently there was no decay of the teeth. No impaction of food was observed on the oatmeal diet and again there was no evidence of caries. The retention of food by the teeth, therefore, seemed to these authors to be a factor in caries.[9]

It is generally agreed that deep pits and fissures in the teeth favor the accumulation of food and predispose to caries because of food impaction. However, this work indicates that the principal difference in the caries-producing and non-caries-producing diets containing cornmeal fed to these rats was the particle size of the corn. The mechanical construction of corn is such that a coarsely ground meal would probably have a very uneven distribution of the vitamin B complex content, and thus, while whole corn was fed, particles of vitamin B complex free corn could lodge in the grooves

of the lower molars, and thus the growth of aciduric organisms would be favored. In the finely ground corn, there probably is a more even distribution of the vitamin B complex content, which might prevent a sufficient growth of the proper aciduric organisms to cause caries.

Koehne, Bunting and Hadley[10] repeated the work of Hoppert and obtained similar results. Koehne states that Hoppert diets, whether caries producing or not, are unquestionably complete nutritionally.[11] The fact that the two groups of rats received the same amount of cornmeal does not necessarily mean that both diets are complete nutritionally. It is conceivable that the rats consuming coarse cornmeal could utilize enough vitamin B complex and mineral substances to insure excellent growth and skeletal development and yet not enough to establish immunity to dental caries. It is possible that the vitamin and mineral substances were not completely available in the coarse cornmeal and were not fully metabolized owing to the smaller surface area exposed to the digestive processes; which might contribute to an inadequate or incomplete nutrition. In view of the fact that the finely ground corn has a greater surface area exposed to the digestive processes, it is probable that it was more completely assimilated, thereby being more adequate nutritionally than the coarse cornmeal. This is an important point, for we can figuratively starve in the midst of plenty, because the body is built and maintained on the food assimilated or utilized, and these processes are not wholly dependent on the amount of food ingested.

Rosebury and Karshan report the study of sixty young rats fed a stock diet high in fermentable carbohydrates (all synthetic). These rats were fed three different diets: a low calcium diet, a vitamin-D-free diet and a vitamin-C-free diet. No dental caries was produced in spite of evidence of retention of food in molar pits, which these authors say indicates the absence in their experiments of one or more factors in susceptibility to caries.[12] This might, on casual reading, seem to disprove the contention that refined carbohydrates are important etiologic factors in dental caries. However, it is interesting to note that a dosage of yeast powder representing approximately four times the quantity recommended as the protective minimum by the manufacturer was given these rats. We know that yeast is a rich source of vitamin B complex and we can assume that some factor in the yeast protected these rats from dental caries. We must not conclude from this that eating yeast is a practical means of preventing dental caries in human beings, although this evidence does seem to support the opinion that a vitamin B complex deficiency is a primary factor in dental caries.

In the process of milling white flour, 100 pounds of wheat is necessary to produce 70 pounds of white flour. The 30 pounds removed in the process contains more than 90 per cent of vitamins B complex and E and approximately 83 per cent of the calcium, phosphorus, copper and iron content. The position of white flour in the etiology of dental caries is not completely understood. We know that it is very deficient in its vitamin B complex content, and, for that reason alone, should not be included in any diet that is designed to maintain health. It is even more dangerous in the diets of growing children, whom we know to be very susceptible to dental caries. Price reports the following observations, which clearly associate white flour and white sugar with dental caries:

> The limited importation of foods to the Tongan Islands in the Pacific due to the infrequent call of merchant or trading ships required the people to remain largely on their native foods. Following the war, however, the price of copra went up from $40.00 per ton to $400.00, which brought trading ships with white flour and sugar to exchange for the copra. The effect of this is shown

very clearly in the condition of the teeth. The incidence of dental caries among the isolated groups living on native foods was 0.6 per cent, while for those around the port living in part on trade foods, it is 33.4 per cent. The effect of the imported food was clearly to be seen on the teeth of the people who were in the growth stage at that time. Now the trader ships no longer call and this forced isolation is very clearly a blessing in disguise. Dental caries has largely ceased to be active since imported foods became scarce, for the price of copra fell to $4.00 a ton. The temporary rise in tooth decay was apparently directly associated with the calling of the trader ships.[13]

This observation of Price seems to indicate that foods deficient in vitamin B complex are important factors in dental caries. It also demonstrates the idea that a high consumption of refined foods tends to pervert the appetite, which eventually leads to a deficiency of other necessary food factors.

It is hoped that this review will tend to clarify the problem of the relation of nutrition to dental caries and thereby permit a general agreement among dental investigators. It is also hoped that it will culminate in a practical and constructive effort toward reducing the consumption of refined cereals and sugars. Decrease in consumption of white flour and white sugar will not only reduce the incidence of dental caries, but will also reduce the incidence of many degenerative diseases due to vitamin B complex deficiencies.

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POSTOPERATIVE HEMORRHAGE

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IN discussing hemorrhage, its causes and treatment, we are dealing with blood and its functions. It therefore would seem advisable to offer a brief description of normal blood and the phenomenon of coagulation.

Blood is a liquid tissue composed of corpuscles, or cells, and a fluid intercellular substance. The cells are of three kinds: red cells, or erythrocytes; white corpuscles, or leukocytes, and blood platelets, or plaques.

The fluid element of the blood is the plasma, an albuminous and saline liquid of slightly varying composition. The blood as a whole is red, rather viscid, and alkaline to ordinary indicators, though actually neutral in reaction. It totals about one-thirteenth of the body weight.

The erythrocytes, or red cells, are yellowish amber biconcave disks of uniform size and regularly rounded. They are composed essentially of an albuminous substance containing hemoglobin, an important element, constituting about 95 per cent by weight of the corpuscles. There are about 5,000,000 red corpuscles to the cubic millimeter of blood.

The leukocytes, or white corpuscles, are rounded or spherical bodies presenting a more or less granular appearance. They are commonly much larger than red corpuscles. There are several varieties of white corpuscles, grouped as follows: lymphocyte, large mononuclear, transitional, polymorphonuclear and eosinophile.

The plasma of the blood is an albuminous liquid containing mainly serum albumin, serum globulin and various saline compounds.

A summary of normal blood findings is given in the accompanying table.

Normal Blood Findings

	Hemoglobin Per Cent	Erythrocytes Million	Leukocytes
Men	90-110	5 -5½	7,500
Women	80-100	4½-5	7,500
Children	70-80	4½-5	9,000

Differential Count

	Per Cent
Polymorphonuclears	65-70
Small lymphocytes	20-30
Large lymphocytes	2-6
Large mononuclears	1-2
Transitionals	2-4
Eosinophils	1-2
Mast cells	0.25-0.5

Coagulation time 3-6 minutes.
Bleeding time 2-4 minutes.

Any deviation from these figures would lead one to suspect a blood dyscrasia.

So much for a brief review of the normal constituent elements of blood.

COAGULATION

The phenomenon of blood coagulation is a normal property of blood when it is outside the blood vessel. In the white corpuscles, there is a zymogen known as prothrombase, which becomes thrombase through the action of the calcium salts. The blood also contains a protein known as fibrinogen. When the blood is released, thrombase acts upon the fibrinogen, and fibrin is produced. The action of fibrin, an insoluble substance, causes the blood to coagulate. The time necessary for coagulation depends on many conditions.

Read before the Marquette Alumni Association, October 28, 1939.

HEMORRHAGE

Hemorrhage is the escape of blood from the blood vessels. This may be arterial, when the blood comes in jets and is bright, except in asphyxia; venous, when it flows in a continuous stream and is dark red, or capillary, that is, an oozing, which ceases on exposure to air.

Hemorrhage may also be divided into primary, when accompanying surgical measures; recurrent, intermediary, reactionary or consecutive, when it follows within twenty-four hours, or secondary, when it occurs any time after twenty-four hours.

The causes of hemorrhage are trauma, surgical operation, irritation, as in the mouth from broken bridges, overextended dentures, loose bone particles remaining after a surgical operation, mucous membrane infection, periodontal disease or malignant growth. Hemorrhage may follow surgical operations in undiagnosed cases of hemorrhagic purpura, lymphatic leukemia or hemophilia.

The symptoms of hemorrhage are readily recognized clinically. There may be persistent slight oozing of blood or spurting of blood. The extensive loss of blood causes faintness and nausea. The pulse is more rapid and weaker. The lips and skin become pale. There is a drop in blood pressure. Headache and dizziness accompany loss of blood.

PREVENTION OF HEMORRHAGE

There are two measures for the prevention of hemorrhage: (1) preoperative or preventive and (2) postoperative.

In the preoperative procedure, a history of the case is taken, also the bleeding and coagulating time are noted and, if necessary, medical treatment is prescribed. When there is a history of hemophilia, diabetes, high blood pressure or general debility, consultation with the family physician is advisable.

I have in mind a case in which these necessary precautions were taken, and still a near fatality resulted.

A patient presented himself to his dentist to have a tooth removed which was causing severe pain. The dentist, on taking the history, learned that the patient had had his spleen removed. The family physician was consulted, and advised removal of the offending tooth. The patient bled profusely at the time, but, after a few minutes, the bleeding stopped. Hemorrhage recurred a few hours later, nearly resulting in a fatality. The patient's blood, which was deficient owing to loss of the spleen, which is supposed to act on the red corpuscles and blood platelets, probably had lost its power of coagulation.

As a preoperative measure, a bleeding and coagulating test can be made. This will not prevent hemorrhage, but if there is a too prolonged bleeding or coagulation time, the necessary precautions can be taken to assist coagulation.

BLEEDING TIME

In determining the bleeding time, the lobe of the ear or the tip of the finger is thoroughly cleansed and a deep puncture is made. At thirty-second intervals, the blood should be blotted off. Bleeding will ordinarily cease at the end of three minutes, but a bleeding time of from six to eight minutes is not abnormal. Pressure should be avoided in the area that is blotted as this will lengthen the bleeding time. The difference between starting time and cessation of bleeding is the bleeding time.

COAGULATION TIME

To determine the coagulation time, a drop of blood is placed on a clean slab with a concavity in it and a convex cover is placed over it. After two or three minutes, the slide is slightly tilted. When there is no longer any gravitation of the blood, coagulation has taken place. It should occur in five or six minutes. Patients having a doubtful bleeding or coagulation time should be treated preoperatively.

Preventive treatment consists of medication orally or intravenously. The medicaments most commonly employed are calcium lactate or calcium gluconate. Styptysate or ceanothyn may be prescribed. A blood transfusion is sometimes advised as a preoperative measure.

Calcium is known to play a definite part in the process of coagulation. A definite decrease in coagulation time is obtained when calcium is administered either orally or by injection. Calcium lactate or calcium gluconate is prescribed, 15 grains four times a day.

The efficiency of calcium is increased when taken in conjunction with viosterol or vitamin D. Vitamin D increases the absorption of calcium from the gastrointestinal tract; therefore, an increase in intake of vitamin D will cause an increase in absorption of calcium and a decrease in coagulation time.

Styptysate and ceanothyn are administered orally or topically.

POSTOPERATIVE TREATMENT

In the treatment of postoperative hemorrhage, four methods can be employed: (1) packing pressure, (2) suturing, (3) a combination of packing and suturing and (4) ligation of the carotid artery. The primary step in secondary hemorrhage is to cleanse the mouth of all clotted blood and locate the bleeding area. The socket from which there is bleeding should be thoroughly cleaned and packed with sterile gauze, saturated with a topical coagulant such as adrenalin, ferric chloride, tannic acid or thromboplastin. The first three medicaments assist coagulation by constricting the capillaries, while thromboplastin augments the coagulation factor in the blood. After the socket has been packed, a pressure pack should be placed over the area and held in place by occluding the teeth or by bringing the jaws together, in edentulous cases. The pads should be held firmly in place for about ten minutes, and then removed; but the socket packing should not be disturbed until from twenty-four to forty-eight hours later, and should then be removed very slowly.

I have used thromboplastin with great success. According to the manufacturer,

> Thromboplastin may be used freely and without any danger. It acts by its power of augmenting the thromboplastic substance of the blood whereby a fibrinous clot is formed and the effect is of a permanent nature.

At times, it may be necessary to suture the tissues of the socket. This is done by deflecting the mucous membrane on the lingual as well as on the buccal aspect of the socket. A section of process is removed, with a rongeur, on both sides, to afford a larger flap of tissue for suturing. The use of sterile silk floss is here indicated to hold the tissues firmly in place. The suture is inserted quite deeply, crisscross suturing is done and the tissues are pulled tightly together. The suture can be removed in about forty-eight hours.

When a combination of packing pressure and suturing is employed, the hemorrhagic area is packed with sterile gauze saturated with a coagulating medium. With silk floss, the mucous membrane is brought together as in the second step. The sutures can be removed within twenty-four hours, but the packing should not be removed until a later sitting. Ligation of the external carotid artery is at times necessary in cases of extreme hemorrhage.

In the treatment of hemorrhage, the patient is instructed to refrain from all stimulants such as alcohol, coffee or tea. Rest is essential. If necessary, the patient should be hospitalized. The mouth should not be rinsed frequently. The patient should be kept warm. A blood transfusion may be necessary when there has been an extensive loss of blood.

Hemorrhages can often be prevented provided a patient is not dismissed too quickly. The operator, before allowing a patient to leave, should be certain that

coagulation has taken place in the socket from which a tooth has been removed.

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FRACTURES OF THE MAXILLA

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FRACTURES of the maxilla, while not so common as those of the mandible, are increasing yearly, chiefly from automobile accidents. In these accidents, the passenger usually suffers a maxillary fracture, while the driver receives a mandibular fracture, because the head of the passenger, who has no means of bracing himself, is thrown forward and the midportion of the face strikes the door fixtures, instrument panel or wind shield; while the driver, bracing himself against the wheel, protects the upper part of the face.

Among the Naval Service personnel, motor accidents occupy first place as a cause of accidental death. These accidents were responsible for 909, or 12.8 per cent, of all accidental injuries in 1937. There were sixty fractured maxillae, sixteen fractured zygomas and three hundred and twenty fractured mandibles. Malar fractures were not tabulated. Thus, we see that of all the accidents incident to naval personnel in 1937, automobile accidents, which were an outside influence, accounted for one eighth of all the admissions.

The maxilla, the largest bone of the face, with the exception of the mandible, is formed by ossifying of membrane from an uncertain number of centers or nuclei, probably five. It assists in forming three cavities: oral, orbital and nasal. Since it helps to form these cavities, a break of the maxilla usually opens into one or more of them. Also, each maxilla articulates with nine other bones: frontal, ethmoid, nasal, malar, lachrymal, palatal, vomer, inferior turbinate and the other maxilla. The maxillae are considered as one bone in fracture cases.

It is evident that any violence applied to the bone will be transmitted to its several articulations, and an injury to it almost always results in injury to one or several of the approximating bones. Therefore, fractures of the maxilla are usually accompanied by fractures of other bones of the face. Consequently, examination of all facial bones should be a routine procedure in maxillary fracture.

A fracture, being a solution or break in the continuity of a bone, constitutes a wound. Its symptoms are those associated with wounds, and treatment is guided by the laws that govern care of a wound in any other tissue.

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The symptoms can be classified as local and general. Under local symptoms are (1) mobility, (2) crepitus, (3) deformity, (4) pain, (5) tenderness upon pressure, (6) loss of function, (7) edema and (8) ecchymosis.

The general symptoms are (1) shock and (2) mental depression.

The treatment consists of (1) correcting the deformity; i.e., reestablishing occlusion and eliminating facial deformity; (2) maintaining the fragments in apposition until healing or union occurs; (3) preventing infection and its sequelae,

Fig. 1.—Application of splint and headcap. The small scar on the cheek was produced by insertion of a hooked instrument for extra-oral reduction of the malar fracture. (Photographs courtesy of R. Woodward.)

and (4) providing all the comfort possible to the patient.

Fracture of the maxilla may be (1) simple fracture of the alveolar process; (2) unilateral fracture; (3) bilateral fracture, and (4) extensive comminuted fracture, complicated by fracture of other bones of the face.

Severe shock and mental depression are not uncommon in this type of fracture. There may be a complete tearing loose of the bone in a bilateral fracture, the fracture line running from tuberosity to tuberosity above the apices of the teeth, in which case the fractured bone is supported only by the soft tissues. If the fracture line runs through the orbits, the whole face will sag and, in this type of fracture, attention must be given to the possibly needed correction of diplopia, which occurs in many cases. Diplopia is double vision due to derangement of muscular balance of the eyes, the image of the object being thrown upon non-identical spots on the retina. This derangement of muscular balance may result from injury to the attachment of the suspensory ligament or from lacera-

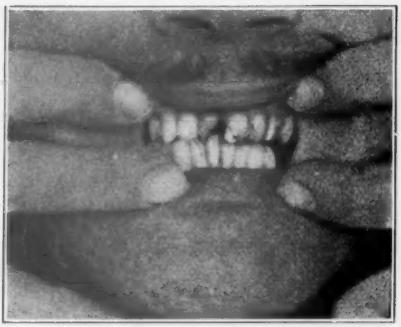

Fig. 2.—Completed case.

tion of the ligament itself. In cases of diplopia, it is necessary that the fracture be reduced with such accuracy that the two eyeballs are on the same horizontal plane or level, that each retina may receive the image of the object on identical spots.

In these fractures, the entire arch is freely movable, but extensive manipulation of the parts in examination is contraindicated, since severe traumatic shock may result from this procedure. Complications may be: cranial or brain injuries; injury to the second division of the fifth nerve, producing anesthesia of the areas supplied by it; injury to the

alveolar branches of the internal maxillary artery, and infections, the worst feared being meningitis.

In cases of extensive comminution, it is the safer policy to delay a few days before approximation of the fragments, in the meantime carrying out conservative treatment, as in a skull fracture, with, in addition, immobilization of the maxilla as nearly as possible with a Barton, four-tailed or similar bandage, using the lower teeth as a splint. Otherwise, avenues to the meninges may be forced open, providing a free pathway for intracranial infection.

According to Major, "It seems probable that the area surrounding a skull fracture is soon walled off by a blood clot, and to manipulate the maxillary fragments at this stage is to re-open the area and increase the possibility of intercranial infection."

Fig. 3.—Application of device to move maxilla forward into correct occlusion.

The line of such a fracture usually opens into at least one or perhaps all of the following sinuses: ethmoidal, frontal and maxillary. Infection of these sinuses in such a case is the exception rather than the rule. Again quoting Major: "Osteomyelitis occurs in from 5 to 10 per cent of mandibular fractures." Our records at the Naval Hospital, San Diego, Calif., show that in 8.03 per cent of mandibular fractures, osteomyelitis developed. However, in the cases developing this complication, five to eleven days elapsed before hospitalization. It seldom develops in the maxillary area, owing to the profuse blood supply and the benefit derived from drainage by gravity along the fracture lines; which is inadequate in the mandibular fractures. The nasal and maxillary sinuses should be provided with drainage, preferably through the nose, however. They should be gently irrigated with a mild antiseptic solution, but under no circumstance should pressure be used, as that may force the infection into other areas, with sequelae fraught with great danger. The nose can be kept open in cases of severe edema by the use of adrenalin or ephedrine nose drops. Cold compresses may be used to reduce swelling, but care should be exercised not to freeze the tissues.

Fig. 4.—Completed case with lower four anterior teeth replaced by bridge. The incisal surfaces of the upper anterior teeth were broken off in the accident.

Hemorrhage into an antrum seldom needs any particular attention, unless there is a septic condition present, as the bleeding is self-limited and usually the blood liquefies and is drained off by gravity. The blood supply being profuse in this area, there is small chance of loss of bone structure unless there is complete detachment. If a fragment is detached, it should be removed, as it will become a source of irritation.

For the same reason, an abundant blood supply, treatment of maxillary fractures, other than those complicated by brain injuries or extensive comminution, should be undertaken within a few days. The fragments are easily manipulated then, but, in time, fibrous union occurs. Organization of the blood clot between the fragments makes coaptation very difficult, and the edges of the fragments may be resorbed, complete reduction becoming impossible, as the fragments are changed in outline.

Bony union occurs more slowly in the maxilla than in the mandible. Usually, only three to five weeks is required in a splint, but, as a general rule, several weeks, and even months, may be required before a firm bony union is assured, with little if any callus formation.

Fig. 5.—Occlusion before reduction.

The violence and the direction of the force govern the amount and line of the displacement. Since there is no strong muscle pull on the maxilla and adjoining facial bones, displacement is caused by outside force, the amount of displacement varying with the violence of the force.

This force may, in unilateral fracture, cause an overriding of the bones at the palatal suture, since the maxilla is forced downward and inward, and thus a clearly perceptible thickened ridge is produced at the suture. A separation of the suture may occur, with the maxilla forced outward. This often tears the overlying tissues. If the tissues and suture are open, it is expedient to employ nasal feeding to keep food out of the mouth, thus avoiding decomposing food débris, the presence of which may have undesirable sequelae in the facial bones.

In alveolar fracture, it is good practice to remove fragments not covered by tissue, since, being continually bathed with saliva, they will necrose and must be removed eventually.

In maxillary fracture, the roentgenogram is not of too great value in determining fracture lines, owing to the superposed structures on the negative; yet roentgenographic examination should never be omitted.

Fig. 6.—Application of headcap and rubber dam to reduce fracture.

In all these fractures, the segments must be brought into alinement according to the former occlusion of the teeth of the patient. In mandibular fracture, the bone can be refractured, but, in the maxilla, since that procedure is not possible, extreme effort should be made to avoid any deformity on the primary union. Failure to do this may result in

external deformity, reducing or destroying function of the teeth. Usually, a perfect functional result assures a perfect anatomic result.

From the many types of appliances and methods used for the reduction of maxillary fractures, we can deduce that no one appliance is suitable and adaptable to all the types of fracture encountered. Each case presents different problems, and the result obtained is in direct ratio to the skill, ingenuity and resourcefulness of the operator. That is, selecting or devising and fashioning an appliance that will maintain the normal bone and facial relationship of the case is in itself a study and plays the all important part in the end-result.

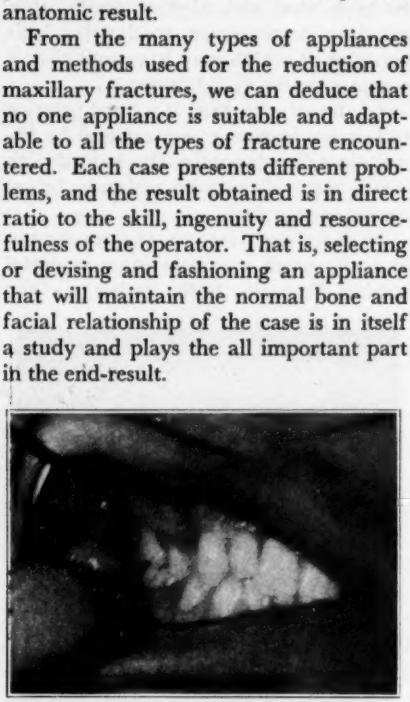

Fig. 7.—Completed case.

We have obtained very satisfactory results at the Naval Hospital, San Diego, with a modification of the Kingsley splint and gummed tape headcap in cases of bilateral fracture. Eight or ten thicknesses of gauze are taped across the forehead, extending downward from the hairline to overlap the inferior border of the finished cap. This gives enough head room that, when the cap shrinks, on drying and being shellacked, the inferior border will not cut into the forehead. A silk stocking top is drawn over the head and the gauze. The tape used is of brown paper, from 1¼ to 1½ inches in width, with a gum preparation on one side, the type used by all commercial firms for the sealing of packages. Strip upon strip is added until the cap is formed over the silk stocking top.

A wire coat hanger is incorporated in the cap, passing laterally over the head, with elongated loops on each side above the ears, extending forward to the orbits. One of the wires passes over the head anteriorly to the vertex and the other passes over posteriorly, this preventing a tendency of the wire to slide anteriorly or posteriorly between the strips of tape when tension is applied on the loops. The anterior and posterior wires are connected by a loop of small gage wire to prevent spreading under tension. The finished cap is shellacked, to strengthen and waterproof it. The cap and gauze are then removed from the patient's head, and holes for ventilation are punched or cut through the tape.

This cap is exceedingly strong and of light weight and is comfortable. Other advantages are the ease in fashioning it; the short time required to make it; its perfect adaptation to the head; the absence of heat on the head, which is always present in setting plaster, and the fact that the materials used can easily be obtained anywhere and at very small expense. When plaster-of-Paris caps are used, there are frequent complaints of headache from the heat and weight of the cap. This is entirely avoided by the use of the light weight, ventilated paper cap.

REPORT OF CASES

Case 1.—An automobile passenger, aged 44, on roentgenographic examination showed fractures at the right zygomalar, frontomalar and maxillary sutures, with displacement of the malar bone downward and backward. There was a comminuted fracture 1.3 by 0.5 cm. in the inferior border of the right orbit and a fracture of the maxilla below the antrum extending to the antrum on the opposite side, with displacement forward of approximately 3 mm. The lower posterior teeth were absent.

Case 2.—An automobile passenger, aged 38, on roentgenographic examination showed

a roughly transverse fracture of the maxilla apparently below the nasal spine, extending from tuberosity to tuberosity, with a backward displacement of approximately 4 mm. A second fracture extended upward and forward from the region of the junction of the vomer and the perpendicular plate of the ethmoid to the level of the floor of the orbit. There was a fracture of the right orbital rim at the suture line of the external angular process of the frontal bone and the frontal process of the malar bone, with a slight displacement, and a simple fracture of the left condyle, approximately 4 cm. from the temporomandibular joint, with slight displacement. Also, a fracture of the labial plate of the mandible including the four anterior teeth in the fragment was present. This fragment was displaced anteriorly approximately 4 mm.

Owing to the condition of the patient, reduction was not attempted for three weeks. Five rubber bands, one-sixteenth inch by 3 inches, were made fast to an upper modified Baker anchorage in the area of the second molars and first bicuspids and opposite the central incisors. These ligatures, under heavy tension, were then attached to the cross wire on the rod at positions that gave a straight forward pull on the maxilla. (Fig. 3.)

CASE 3.—An automobile passenger, aged 22, on roentgenographic examination showed fracture of the maxillae with a line extending below the antrum on each side. Displacement posteriorly was present.

As previously stated, many methods and appliances are used for reduction of maxillary fractures, but each case presents its own problems, and, to obtain the desired result, the skill and ingenuity of the operator are taxed. The end-result often depends on the degree of skill and ingenuity possessed by the operator. And so I repeat that selecting or devising and fashioning the appliance for the case that will obtain and maintain the normal bone and facial relationship is a study and plays the all important part in the end-result.

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Note. All assertions and opinions expressed in the above article are those of the writer and are not to be construed as official or to reflect the views of the Navy Department or the Naval Services at large.

FACTORS IN POROSITY IN VULCANITE

By P. B. Taylor, A.M., Cleveland, Ohio

IN most of the classic explanations of porosity of vulcanite found in dental literature, the vulcanization of rubber is looked upon as similar to the roasting of a cut of beef; that is, the external portions cure first and then the inner regions. In accounting for porosity by means of this conception, as a working hypothesis, it is assumed that the outside cures first and, by hardening, entraps any gas which may be evolved from the inner regions.[1]

Figure 1 shows that the foregoing description of the curing process is not correct. From Figure 1, A, the cross-section of a specimen at an early stage of vulcanization, it is quite obvious that the central portion cures more rapidly, as indicated by the darker shading in this region. Figure 1, B, presents a specimen that is even more thoroughly in disagreement with the popular conception. In this case, a specimen has been prepared which is very porous in the central region even though the external portion is still soft. The most obvious means by which the inner region could cure more rapidly than the outside would require that the interior reach a higher temperature. If this assumption is valid, the temperature of the rubber ought to rise above that of its environment.

By varying the curing temperature from 140° C. (284° F.) to 170° C. (338° F.), Perks[2] found temperatures within the rubber from 30° C. (86° F.) to 95° C. (203° F.) above the curing temperature. The experimental conditions under which his observations were taken make it rather difficult to apply them to dental vulcanization. Perks used cylindrical specimens 1½ inches in diameter with a height of 6½ inches, which were packed in a relatively thin-walled container and vulcanized in a bath.

In dental vulcanization, since much less bulk is used, a smaller rise in temperature would be expected, because the smaller specimen would have a relatively greater quantity of its heat wasted. However, in the dental procedure, the rubber is quite well insulated by the investing plaster; which would tend to counteract the effect of reduced bulk. As a result of these considerations, it was believed that observations similar to those of Perks, and which would more nearly approximate dental conditions, should be made.

The procedure used in this study was to embed a platinum-rhodium thermocouple in the center of a cylindrical specimen of olive base rubber. The height of the specimen was 2 cm. and the diameter varied from 19.6 to 18 mm. The assembly was placed in a vulcanizer and the temperature of the rubber determined by a Leeds and Northrop potentiometer. The temperature of the vulcanizer was determined by the use of a thermometer, the unprotected bulb of which extended into the pot approximately 1 inch. The set-up used is shown in Figure 2.

The temperatures measured by the potentiometer are not accurate to better than ± 1 degree C. Readings were taken every two minutes during the periods of

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heating, while the rubber was changing temperature slowly, and at one-minute intervals during the period of rapid temperature change. If subsequent remarks are restricted to a discussion of smooth curves drawn through these points, the results will be well within the 1 degree C. error of the instrument.

Variation introduced by failure to locate the thermocouple junction in precisely the same point within the specimen would give rise to a considerably greater error. The difference of approximately 6 degrees C. between the peak temperatures reached in the trials (Figs. 3-4) is probably due largely to this fact. The temperatures of the vulcanizer and the rubber are plotted together, the vulcanizer temperature in all cases being the curve which rises more rapidly and remains

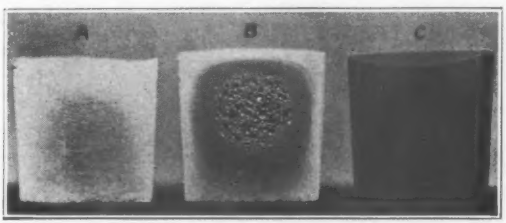

Fig. 1.—A, an early stage of curing. B, uncured outside with porous center. C, sound specimen.

constant at the curing temperature. Since the temperature gradient within the specimen is smaller at lower curing temperatures, the results should show better agreement, as can be illustrated by the maximum temperature reached by the rubber when cured at 150° C. (302° F.). (Figs. 9 and 11.) In consideration of this effect, the curves were selected as follows: If two trials agreed, it was assumed that the thermocouple had been successfully located in the center; otherwise, three trials were made and the curve that gave the greatest temperature rise was selected.

It will be noted by inspection of the curves that for every temperature studied, the rubber evolves sufficient heat rapidly enough to raise the temperature of the rubber above that of the vulcanizer. If the temperature of the rubber rises to 175° C. (387° F.),[1] the substitution reaction proceeds rapidly between the sulfur and the rubber. This, of course, gives rise to the evolution of hydrogen sulfide, accompanied by porosity. (It may be of interest to point out that porosity in methyl methacrylate is produced similarly, since the monomer, which is used as a plasticizing agent, evolves considerable heat during polymerization. A specimen of this material prepared as were the rubber specimens reached a temperature of 147° C. [297° F.] when cured in boiling water. The porosity was of the same nature as that exhibited by vulcanite, but less extensive. The explanation is self-evident, in view of the fact that the monomer boils at 100-101° C. [212-214° F.].)

It is evident, from inspection of the curves (Figs. 3 to 11), that a specimen of this particular rubber and dimensions will become porous if the temperature of the vulcanizer is run up to more than 150° C. (302° F.). As can be seen, even this curing temperature brings the rubber very close to the critical temperature of 175° C. (347° F.) by reaching 170° C. and 172° C. for the two trials shown.

An important characteristic of these curves is the rapid increase and decrease in the temperature of the rubber. It is natural that this take place more rapidly at the higher curing temperatures, since, in general, chemical reactions are accel-

erated by increasing the temperature. Theoretically, this phase of the curve may be interpreted as evidence that the vulcanization reaction is two-staged, or merely that the central portions fully cure in approximately the time required to reach the peak of the curve. Regardless of which explanation is preferred, the practical application will be the same. In subsequent discussion, the generally accepted first hypothesis, i.e. a two-stage reaction, will be accepted. The observations based on this particular portion of these curves then lead to the conclusion that the initial stage of the vulcanization reaction is strongly exothermic and the remainder of the reaction evolves little or no heat.

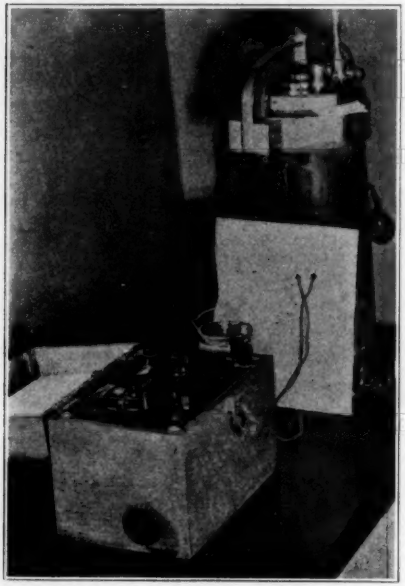

Fig. 2.—Experimental set-up.

If this is the condition, after this initial vigorous reaction has spent itself, the temperature of the vulcanizer might be increased without having the heat of reaction of the rubber raise the temperature to that at which the substitution reaction takes place.

The curves in Figure 9 show the result obtained when the specimen is subjected to these conditions. As can be seen, the vulcanizer was held at 150° C. (302° F.) until the initial stage of the reaction spent itself, after which the curing temperature was raised to 170° C. (338° F.). After the initial reaction has taken place, the rubber will not evolve heat, or at least not rapidly enough to raise the temperature above that of the vulcanizer. If the curing temperature is increased to 176° C. after the first stage of the curing process, the reaction becomes sufficiently exothermic to raise the temperature of the vulcanite to 188° C. (370° F.), as illustrated by the curves in Figure 11. However, even though this considerably exceeds the critical temperature of 175° C. (347° F.), a specimen thus cured exhibited no porosity, as shown by Figure 1, C. All specimens that were permitted to rise above 175° C. (347° F.) during the early stages of the reaction exhibited porosity when sectioned. This would indicate that there is little likeli-

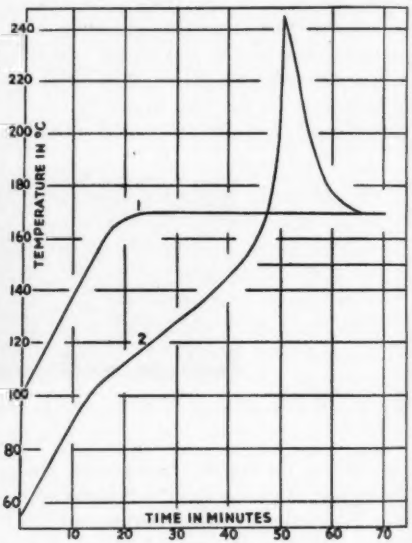

Fig. 3.—Temperature rise in curing at 170° C. (cold mold).

hood of the specimen showing porosity if the initial stage of the reaction between the rubber and sulfur is carried out with the proper precaution.

By "porosity," we mean that macroscopic effect so readily discerned. It is probable that there is some alteration in the microscopic porosity by variation in the curing process, especially in a cure like that shown in Figure 11. Hydrogen sulfide is evolved, but not with sufficient rapidity to have the effect usually associated with the term porosity. For that matter, all vulcanized rubber evolves

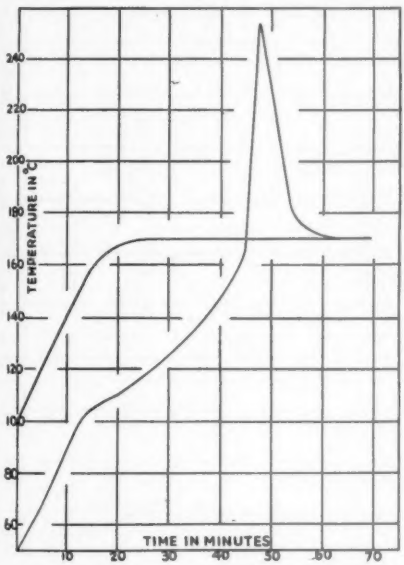

Fig. 4.—Duplication of results in Figure 3.

hydrogen sulfide in very small quantities at any temperature above 25° C. (77° F.).[3] This might be a possible explanation of the clinical observation that old and much repaired vulcanite tends to become brittle.

From the observations made thus far, it is apparent that rubber vulcanized as it commonly is in dental practice would show a difference in the rate of cure between the outer and the inner portions. The external regions will cure more slowly, because the investing medium maintains this section at a lower temperature. On this basis, it is reasonable to assume that in curing a denture of considerable variation in bulk, the thin portions should be given first consideration, the bulky regions being permitted to become overcured, if necessary. For a case that has considerable bulk, a safe cure would be that indicated in Figure 9, in which the vulcanizer is held at 150° C. (302° F.) until the initial stage of the reaction is complete and the curing temperature is then raised to finish the curing

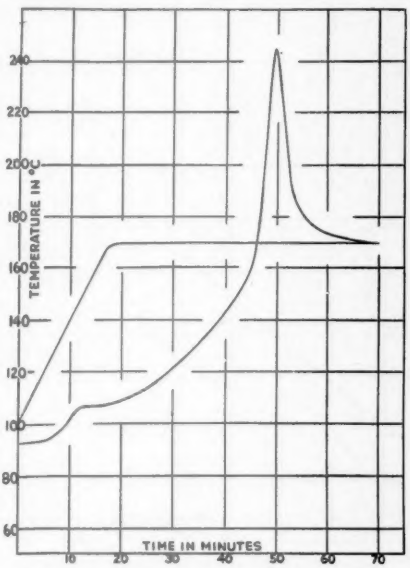

Fig. 5.—Duplication of results in Figure 3, using hot mold.

process. Obviously, the only purpose in raising the temperature is to save time.

As has been mentioned, the rubber used in this study was olive base. This product has a negligible amount of filler and, as a consequence, would be expected to exhibit the maximum effect that might be observed in using dental rubber. Since the heat evolved is produced by the rubber-sulfur reaction, the heating effect would obviously be proportional to the

per cent by volume of rubber-sulfur present, if the accelerator is constant. (Deviation due to differences in specific heats would certainly be well within experimental error.)

On this basis, the temperature rise to be expected was calculated for a red base rubber. The experimental value was slightly high, but within the experimental error discussed earlier. The agreement was more than adequate to establish the fact that the inclusion of a filler would reduce the heating effect and result in a decrease in tendency toward porosity.

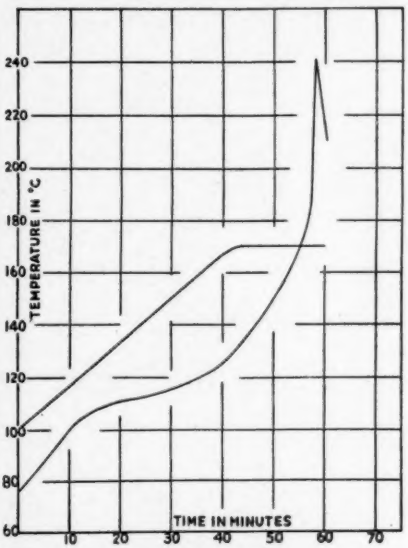

Fig. 6.—Duplication of Figure 5 with prolonged run-up time.

It follows, from these observations, that finely ground vulcanized rubber added to fresh stock for use in a bulky denture would act much as any other filler. Since the initial stage of the reaction has been passed by this portion of the mixture, it would not contribute to the heating effect that accompanies the curing process. The use of finely ground rubber is more desirable than use of other fillers because it will not have the usual deleterious effect upon the physical properties of the finished case.[4]

The possibility of reducing or eliminating porosity by the running-up time warrants consideration. Figures 3 to 6 show the difference in temperature lag between the vulcanizer and the rubber as affected by variation in the running-up period and the initial temperature of the flask. The difference in the lag is not great enough to be of practical consequence when these factors are varied within reasonable limits. In each case, the temperature difference was largely confined

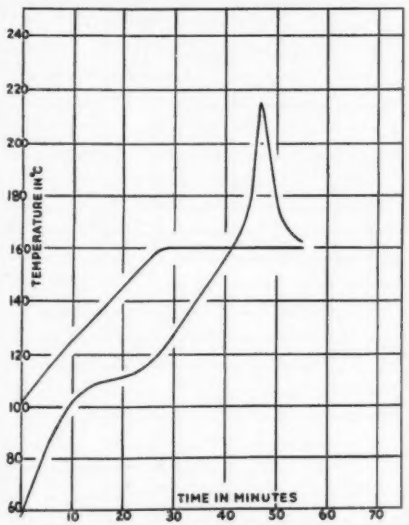

Fig. 7.—Temperature rise in curing at 160° C.

to the early stages of heating, little or no effect being observed in the maximum temperature reached by the rubber. As may be noted, the lag is less than that reported by Kimball and Peyton.[5] Inspection of the curves in Figures 7 to 10 shows that lag becomes greater for decreasing vulcanization temperatures. This suggests that the difference between these results and those of Kimball and Peyton may be accounted for by the fact that, in some cases, these investigators used

no rubber and, in others, smaller amounts of rubber were used than in this study. In any event, the results indicate that time would have to be extended sufficiently that the preliminary cure would be effected at a reduced temperature, as

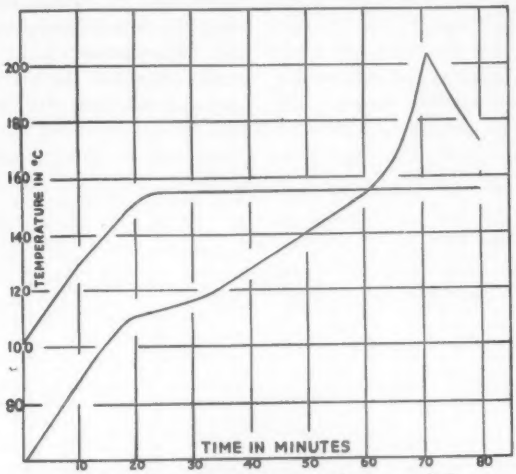

Fig. 8.—Temperature rise in curing at 155° C.

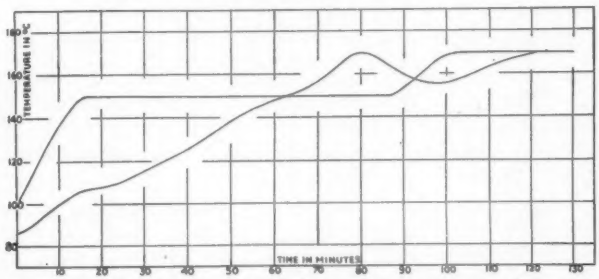

Fig. 9.—Temperature rise in curing at 150° C.; temperature increased to 170° C. after initial stage of reaction.

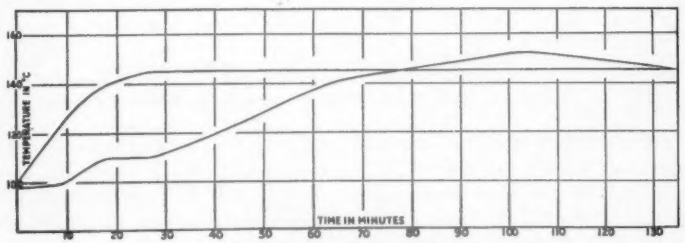

Fig. 10.—Temperature rise in curing at 145° C.

rubber cannot be rid of porosity by any reasonable prolongation of the running-up time of the vulcanizer. The running-up suggested above. Such a vulcanization procedure would require too long a time to be of practical value, since there is

a more expedient method, as suggested earlier.

It is of interest to compare the relationship between curing time and temperature for the first stage of the reaction with that found for the complete reaction. For this purpose, let us assume that the speed of the first stage of the reaction would be proportional to the time required to reach the maximum given degree of cure at a temperature T_1 in degrees C.

The equation set up above would not represent the relationship accurately, since the actual curing temperature is not the temperature of the vulcanizer, but varies between the curing temperature and the maximum temperature reached by the rubber. At the higher curing temperatures, the greater activity would

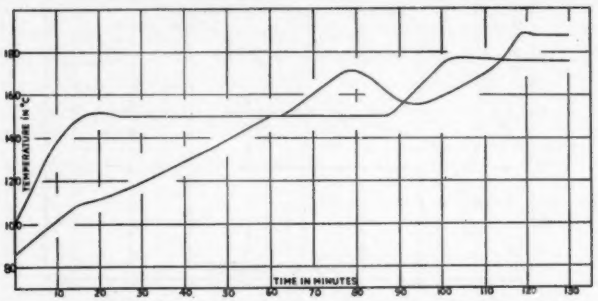

Fig. 11.—Temperature rise in curing at 170° C.; temperature increased to 176° C. after initial stage of reaction.

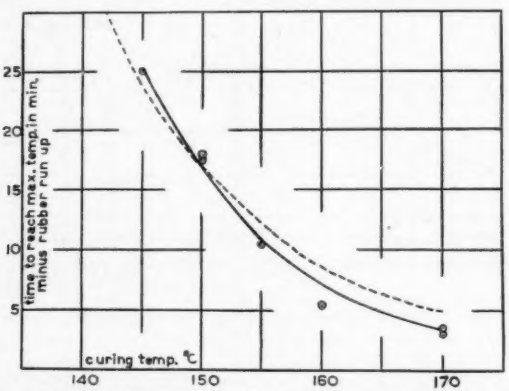

Fig. 12.—Relationship between curing temperature and rate of reaction.

temperature after the rubber had reached the temperature of the vulcanizer. The curve obtained by plotting these times as a function of the curing temperatures is shown by the solid line in Figure 12. This curve is well approximated by the equation $\log \frac{t_1}{t_2} = 14.5 \log \frac{T_2}{T_1}$ where t_1 is the time in minutes required for a give rise to a greater error in the assumption, which would cause the constant in the equation to be greater than if it were possible to represent the relationship more accurately. In other words, 14.5 would be smaller if correction due to rise in temperature could be applied.

The relationship between time and temperature[6] has been previously deter-

mined by another means; viz., observations of the minimum cure at various curing temperatures which will assure maximum tensile strength. From this study, the relationship was found to be:

$$\log \frac{t_1}{t_2} = 10.27 \log \frac{T_2}{T_1}$$

(The dotted line, Figure 12, is the curve of this equation.)

Since the constants are nearly alike, it is not entirely improbable that the correction which should be applied to constant 14.5 would reduce the two relationships to the same equation within experimental error.

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MINIMUM ESSENTIALS FOR TOOTH REMOVAL OPERATIONS

By Henry B. Clark, Jr., M.D., D.D.S., and Henry B. Clark, D.D.S., St. Paul, Minn.

ONE of the most vicious expressions in the field of dentistry is the term "simple extraction." It implies that one can tell by examining the crown of a tooth whether the operation will be done with ease or difficulty. Inasmuch as the removal of a tooth is an operation, and since any operation is attended with some degree of risk and the opportunity for accidents to occur, it should not be undertaken until everything possible has been done to insure the safe, speedy and sure completion of the procedure.

The preparations necessary to this end are not simple, yet if one takes the responsibility seriously and establishes the same thorough routine for each case, accidents will seldom happen, and the surgical phase of dentistry will become a source of much pleasure and satisfaction.

Let us then first consider the preparations that we would make in advance for a known difficult extraction. If we can then be convinced that every tooth removal is potentially a difficult one, it will become apparent that the only correct procedure is to conduct each case with the same degree of thoroughness.

MINIMUM ESSENTIALS

The minimum essentials for each case are:

1. A clear, recent x-ray picture of the tooth and surrounding tissues.
2. A suitable anesthetic agent.
3. A good suction apparatus.
4. Brilliant illumination.
5. A competent assistant.
6. Suitable forceps and elevators.
7. A tray of instruments for performing flap procedures.

It may seem at first glance that these requirements are too exacting, and that

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all will not apply to each case. This is, of course, true. The abdominal surgeon of the present day may use in a given operation no more equipment and facilities than the "horse and buggy doctor" employed in his kitchen table operations, yet he needs the assurance of additional aids when an emergency arises. None of us can rationally hold that "horse and buggy" exodontia is justifiable today. Unfortunately, even the best is none too good at times.

Let us now consider the requirements in greater detail.

1. *A Clear, Recent X-Ray Picture of the Tooth and Surrounding Tissues.*—Every one will doubtless agree that this aid is desirable in all cases. The old motto "ought means must" could well be applied to preoperative pictures. It is impossible to compromise on this point, as the very case in which a roentgenogram is omitted may be that in which an accident or serious error occurs. If one wishes to limit extractions to uncomplicated cases, the roentgenogram is the only means at hand that will be really helpful in selecting his cases. If a tooth is loose, there may be a cyst or tumor present. Even if the need for extraction is obvious, the evidence recorded on the film may be of great help should the operator later be accused of having removed the wrong tooth. Frequently, an adjacent tooth may be as badly diseased as the one that brought the patient to the dentist. The issue is much the same as in the breaking of a bad habit: there can be no exceptions to the newly formed, correct habit. As in any superior dental service, the element of cost is not to be emphasized. The cost of the film is best included in the fee quoted for the operation, and, in the case of worthy patients who object to a roentgenographic examination on the grounds of expense, the service may be furnished gratis. It is the dentist himself who suffers when he attempts to work under an inadequate diagnosis.

2. *A Suitable Anesthetic Agent.*—The use of gas should be avoided for impacted or devitalized teeth or for operations requiring trimming and suturing, unless a trained surgical team is at hand. Local anesthesia affords a universally applicable service, and is to be preferred except in the presence of acute infection. Even in seemingly simple operations, there are always things that can be done, such as trimming or suturing, which will be left undone under general anesthesia, but will be undertaken if the anesthesia is local. The most important factor of all in the use of local anesthetics in dentistry is that the syringe and needle be boiled prior to use. This warning cannot be stressed too strongly. Most cases of serious infection following extractions can be traced to cold "sterilization" of the injection needle.

3. *A Good Suction Apparatus.*—The inclusion of this point may amuse many men who feel that sponging with gauze or cotton is adequate for the removal of blood and other fluids from the mouth, but it is our belief that the suction principle in exodontia constitutes the greatest single advance in recent times. Several outstanding advantages commend it to our use:

a. When the suction tip touches the floor of the mouth or is inserted in the socket, a bloodless field is instantly created.

b. The operator is not only relieved of the delay occasioned by the sponging, but is able to achieve a degree of dryness and vision otherwise impossible. This makes easy the removal of root tips, etc., which might otherwise be almost impossible.

c. The fact that bacteria and other débris are constantly being removed from the socket contributes to the sterility of the wound and reduces the incidence of "dry socket." In the gauze or cotton sponging technic, foreign matter is constantly being introduced into the socket, where the sharp bony points will catch

and hold the minute cotton fibers. Since the entire mouth can be kept dry, there is no need for the patient to rinse the mouth or expectorate, and saliva does not enter the wound.

d. The initial cost is the only one. The saving in time and expense over the sponge technic will soon pay for the apparatus. The added speed in extraction operations also constitutes a most important factor to patient and dentist alike.

A detailed description of the suction apparatus will not be given, as many supply houses are now prepared to furnish and install it at very reasonable cost. A resourceful dentist can construct his own with the aid of a good machinist or plumber.

4. *Brilliant Illumination.*—Good light is imperative. The preferred source is one which does not have to be held in the hand, namely, a head light or mirror. If this is not practical, an efficient shadowless spotlight will serve.

5. *A Competent Assistant.*—No extraction should be attempted under gas without a surgical assistant in addition to the anesthetist and operator. Procaine should not be used unless a nurse is able to give uninterrupted assistance with the operation. It is not fair to the patient to unduly prolong unpleasant procedures which could be carried out better and in less time if a second pair of hands were available. The practice of attempting extraction alone is thus to be condemned. If we put ourselves in the place of the patient, or if he could be endowed with our knowledge of the situation, the issue would be more clear. If the practice does not warrant an assistant for full time, one may be engaged for half days, and all extractions be performed while she is in the office. Two nurses or office attendants are desirable; one is essential.

6. *Suitable Forceps and Elevators.*—We shall not attempt to name or describe the actual exodontia forceps and exolevers that should be at hand. Three upper and two lower forceps do nicely, and four crossbar elevators (two pair) will fill most needs. It is essential that elevator points which are designed to engage or bite into cementum or dentin be kept perfectly sharp by frequent applications of the stone.

7. *A Tray of Instruments for Flap Procedures.*—The required instruments are as follows: (a) a small sharp scalpel; (b) a periosteal elevator; (c) a small ribbon retractor or tongue blade; (d) a three-sixteenths-inch straight sharp chisel; (e) mallet; (f) needle, needle holder and suture material; (g) scissors; (h) a straight, stiff explorer, and (i) a rongeur.

These instruments must be boiled and kept sterile, in readiness at all times on a small enamel ware tray covered with a sterile or perfectly clean towel. Only if they are always at hand will one resort to their use promptly, as he should, when the need arises.

The small expense required to procure this emergency outfit is soon forgotten in the additional enjoyment from performing oral operations properly. It is an established fact that a flap operation well done is always good surgical procedure, and should be resorted to without delay as soon as root fracture occurs, or when a tooth fails to move after repeated applications of the forceps. At the risk of repetition, we shall submit the technic for one form of flap operation for the removal of fractured roots or teeth that cannot be delivered by the forceps.

FLAP OPERATION

1. A bold, vertical incision is made from the free gum margin rootward for one-half to three-quarters inch, at the middle of the tooth immediately ahead of the fractured one. The incision is made two or three times to make sure all strands of soft tissue, including periosteum, are severed.

2. With the periosteal elevator, the entire flap is carefully raised backward

and rootward, tearing being avoided, until the bone is bare and exposed to view over the entire buccal aspect of the root.

3. With the retractor in the left hand, the flap is held back, being left in this position until completion of the operation, since repeated manipulation will unduly traumatize it. With the mallet and chisel, all the buccal bone is shaved away, care being observed to prevent injury to the adjacent teeth, but to make sure that the buccal surfaces of the root tips, if present, are denuded over half their circumference. This step must be carried out fully. It will then be possible, with any thin-bladed elevator, to gently pry the root from its socket, or narrow beaked forceps may be easily applied. In the case of the lingual root of an upper molar, exactly the same method should be followed, with removal of all bone which prevents a view from the buccal aspect.

4. The wound is then inspected and cleaned of all chips of bone. Granulomata may be carefully peeled out with a small curet.

5. The edges of the socket are then slightly beveled with the chisel or rongeur, and any sharp bony processes found on finger tip palpation are conservatively trimmed.

6. One or two simple sutures are then placed across the line of incision and tied snugly, but not tightly. The healed incision will show only as a fine white scar. The purpose in having placed the incision at the midline of the next tooth ahead is to provide a definite plateau of undisturbed bone on which the free edge of the flap can rest, and it is essential if curling in of this edge of the flap is to be avoided.

Any one who would attempt the removal of teeth must be prepared to carry out this technic promptly. It is the answer to the question, "How do you take out broken roots?"

CONCLUSION

Let us all face the issue squarely. There are too many patients who can tell of two or three hour sessions with a tooth extraction. There are too many who are carrying root fragments in their jaws today. Too many average extractions have taken three or four times as long as was necessary. Osteomyelitis, pterygoid abscess, cervical cellulitis, fracture of the jaw, dry socket and a jagged condition of the ridges are still following operation for the removal of teeth. It is time that each of us establish a code of "minimum essentials" for tooth removal operations.

SUMMARY

1. Every operation for the removal of a tooth should be preceded by an x-ray examination.

2. Every extraction operation should be prepared for as if it were going to be very difficult.

3. This routine should be observed in every case, without exception, for the purpose of avoiding the common accidents and complications associated with tooth removal.

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CONSTRUCTION OF LOWER ANTERIOR PONTICS WITHOUT DISPLAY OF GOLD

By S. E. Brice, D.D.S., Los Angeles, Calif.

ONE of the most difficult problems in the entire field of fixed bridgework is the restoration of the lower anterior teeth which combines sufficient mechanical strength with desired esthetic results.

The following technic is presented in the hope that it may, in a measure, aid in the solution of this problem, especially in the matter of eliminating visible gold from the incisal area of the bridge.

The abutment teeth having been prepared; wax patterns for abutments obtained; castings made, placed on abutment teeth and finished; impressions for the bridge taken, and casts of the case mounted on the instrument, the details of procedure are as follows:

PREPARATION OF FACINGS

Steele's facings of proper shade and dimensions (Fig. 1, A) are ground to an initial adaptation to the cast, the operator making sure that they are ground sufficiently at the gingival portion to allow for constructing complete porcelain tips with medium fusing porcelains, without exposing the ground gingival end of the facings in the completed pontics.

CONSTRUCTION OF PORCELAIN TIPS

Mounted stone No. 44½ (Fig. 1, C) is used to enlarge slots in the facings sufficiently to permit their removal labially from the backings. (Fig. 1, B.) The facings are mounted on an instrument constructed to facilitate building the incisal and gingival porcelain tips at the same time. The instrument should be so adjusted that when the facing is mounted, space will be provided for building porcelain tips of proper length.

The incisal tip should extend from incisal edge to incisal end of the slot. The incisal edge should not be cut to reduce the length of the facing. The gingival tip should, when finished, be of sufficient length that the gold backing will not be in contact with gingival tissue when the completed bridge is placed in position in the mouth. The incisal tip should have sufficient labiolingual thickness to reproduce this dimension of the lost members, or for the ideal restoration of the case. The labiolingual thickness of the gingival tips is governed by the requirements for adaptation of the bridge to the gingival tissue of the case for which it is constructed.

Medium fusing porcelain body having been added to the facing on the instrument and built to the gross outline of the porcelain tips, the facing is removed from the instrument and placed on the stand for firing. This procedure is repeated with all the facings for the case, and the group placed in the furnace and fired to a high bisque finish. (Fig. 2, A.)

SHAPING PORCELAIN TIPS

The incisal tips are ground to the labiolingual thickness indicated for the case. The incisal edges of the incisal tips are ground flush with the incisal edge of the facing or to whatever shape is necessary to assure the esthetic results required by the case.

The proximal surfaces of the incisal tips are ground flush with the facings. The gingival tips are ground to proper size and to the shape required for final adaptation of the case to the cast. (Fig. 2, B.)

If esthetics requires, special grinding of the incisal edge to represent the effect of abrasion or grinding in the labiogingival area of the facings to represent erosion should be done at this stage of the procedure.

The facings are returned to the furnace and fired to full glaze. (Fig. 2, C.)

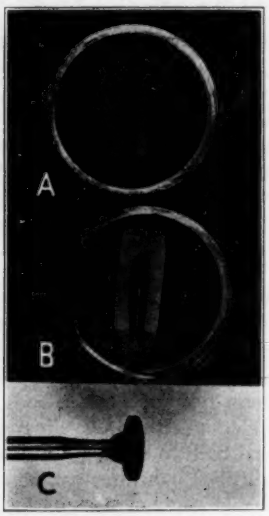

Fig. 1.—A, Steele facing before grinding. B, slot ground to permit labial removal of facing. C, No. 44½ mounted stone.

Staining to represent special coloring in the teeth, if required for the desired esthetic results, should be carried out at this stage of the procedure.

FINAL SHAPING OF TIPS

With a vulcocarborundum disk, the surfaces of the porcelain tips which contact the incisal and gingival ends of the backing are ground to a plane surface, which will form an obtuse angle with the lingual surface of the facings. This angle should be about 93 degrees for the incisal tip and about 104 degrees for the gingival.

These surfaces are hereinafter referred to as the backing surfaces of the incisal and gingival tips. This greater degree of inclination of the backing surfaces of the gingival tips makes possible a proper labiolingual inclination of the triangular grooves, which are later to be cut in the proximal surfaces of facings.

With a vulcocarborundum disk, the mesial and distal proximolingual surface angles of the facings are beveled from the incisal edge to the junction of those angles with the mesial and distal backing surface angles of the gingival tips. (Fig. 3, A.)

Fig. 2.—A, incisal and gingival tips fired to high bisque. B, tips ground to final adaptation to cast. C, tips fired to high glaze.

CUTTING TRIANGULAR GROOVES

With a sharp mounted stone No. 35

(Fig. 3, B), definite triangular grooves are cut in the mesial and distal surfaces of the facings, extending labially from the junction of the lingual surface of the facing with the backing surface of the gingival tip, as far as esthetic requirements will permit, and in line with the inclined backing surface of the gingival tip.

The backing surface angle of the gingival tip is beveled in such fashion that it is continuous with the gingival bevel of the triangular grooves. (Fig. 3, C.) In cutting these grooves, the flat end-surface of the inverted cone-shape stone should be placed toward the incisal edge of the facings, thus providing a flat seat for the porcelain and the maximum resistance to incisal stress when the facings and backings are finally assembled in the bridge. Only the best quality of stones with perfect cutting edges should be used for this purpose.

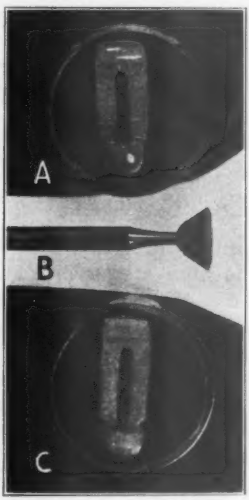

Fig. 3.—A, mesial and distal proximolingual surface angles beveled. B, mounted stone No. 35. C, mesial and distal triangular grooves.

These grooves are cut for the purpose of providing resistance to incisal stress and retention of the facing on the backing in addition to that provided by the slot in the facing and the rib on the backing. Cutting these grooves is an extremely important step in this technic, and on their accuracy of form, position and inclination of angle from the long axis of the lingual surface of the facings largely depends the success of the pontic when the bridge is placed in the mouth and subjected to the stresses produced by the mandible in function.

Fig. 4.—A, platinum gold backing ground to proper size for facing. B, wax pattern for completion of cast backing. C, backing and facing before assembling.

ADAPTING BACKINGS TO FACINGS

Platinum gold backings are cut to proper length to be placed on the facings between the tips. The width of the backing is reduced to cover the lingual surface of the facings only to the mesial and distal bevel of facings. The corners of the backings, which are in contact with the backing surface of the gingival

tips, are cut sufficiently to fully clear the triangular grooves. (Fig. 4, A.)

The backings are placed on the facings and inlay wax is adapted and carved to proper form for the case, the wax being allowed to extend to the linguo-incisal angle and to the entire peripheral bevel of the facings. (Fig. 4, B.) The waxed backings are removed from the facings, invested and cast in the usual manner. The cast gold backings are placed on the facings and finished to perfect margins.

The pontics are now assembled on the cast and held in position by sticky wax. The facings are removed and the bridge is invested, soldered and cleaned with acid. The facings are placed on the backings and the bridge is finished and

Fig. 5.—Completed case.

given its final polish preparatory to being placed in position in the mouth. (Fig. 5.)

With this technic, results very closely resembling those found in nature are possible. By careful planning, the pontics can be arranged in irregular fashion, as they often occur; e.g., staggered or overlapping in position. In the latter, it is necessary to so plan the arrangement of the pontics that their position will not prevent placing facings on the backings after the bridge is soldered.

The incisal porcelain tip can be made thick labiolingually to reproduce the effect of wear, and the incisal surface be given the concave shape, or cupped-out form, often observed in those cases. The gingival portions may be ground to represent the effect of erosion as found on the teeth to be removed, or on those remaining in position when the case is presented.

It has great possibilities for esthetic results, in close harmony with the remaining teeth, in those cases which require special blending of colors by staining.

Bridges for cases with extremely short teeth may be constructed to fully meet esthetic requirements by the use of facings with only the incisal porcelain tips, and grinding the gingival end of the facings to a proper adaptation to the cast.

The incisal tips having been fired and ground to form as described above, the gingival end of the grooves in the facing are ground to a form which will provide a seat for the facings on the backings when assembled. The facings are returned to the furnace and glazed. This treatment of the gingival end of the facings will provide greater strength and better protection of the porcelain than the conventional Steele method, and will necessitate close proximity of the gold to only a small area of the gingival tissue when the bridge is placed in position in the mouth.

The possibility of eliminating gold from the incisal area of the bridge and the esthetic results that are possible seem to justify sacrificing the gingival porcelain tips.

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DENTAL NEEDS OF GRADE SCHOOL CHILDREN OF HAGERSTOWN, MD.*

By JOHN W. KNUTSON, D.D.S.; HENRY KLEIN, D.D.S., and CARROLL E. PALMER, M.D., Washington, D.C.

CURRENT nation-wide interest in the subject of adequate dental care has created a pressing demand for quantitative facts concerning the problem of dental needs. Since a knowledge of such facts would appear to be a prerequisite to an intelligent discussion of this problem, we are placed somewhat in the position of being asked to examine, critically, Duchamp's modernistic painting "Nude Descending the Stair." Those interested in architecture would undoubtedly be baffled by an inability to count or visualize the form, size and style of the stairs, but most of us would be frustrated by our inability to discern the delineating characteristics of the nude.

Similarly, we are now confronted with the task of analyzing the problem of dental needs with little more than the equivalent of an artist's concept to guide us. Obviously, such statements as "More than 90 per cent of all children aged 15 and older have dental defects" contribute little toward a knowledge of the prevalence and incidence rates of defects in the teeth of a community. It is apparent, therefore, that recent interest in the subject of dental needs and adequate dental care has awakened us to a glaring deficiency in our present dental knowledge; namely, the paucity of quantitative, epidemiologic data on dental disease; or, more precisely, the gross neglect of the field of vital statistics of tooth populations.

STUDY GROUP AND FINDINGS

A realization of this need for data on the epidemiologic characteristics of dental caries was the basis for a recent detailed dental survey of the grade-school population of Hagerstown, Md., an urban community having approximately 30,000 inhabitants. The 4,416 white children examined by dental officers of the United States Public Health Service constituted 94 per cent of the enrolled elementary school population. Briefly, an analysis[2] of the data indicated that, in these children, approximately 12,000 permanent teeth had been attacked by caries and that, roughly, 24,000 permanent tooth surfaces were involved. Of the deciduous teeth present, roughly 10,000 were carious, 22,000 of their surfaces being defective.

The age distribution of these defects per hundred children, specific for age and sex (Tables 1, 2, 3 and 4), is shown in Figures 1 and 2, which indicate graphically the striking manner in which, for these grade-school children, dental needs as represented by carious defects in the deciduous teeth constantly decrease with age, while those represented by carious defects in the permanent teeth constantly increase. It will be noted that age 10 represents approximately the age when defects in the permanent teeth are about equal to those in the deciduous teeth,

*From Child Hygiene Studies, Division of Public Health Methods, National Institute of Health, U. S. Public Health Service.

Read before the Section on Children's Dentistry and Oral Hygiene at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 18, 1939.

TABLE 1.—NUMBER OF CHILDREN, NUMBER OF DECAYED, MISSING AND FILLED (DMF) PERMANENT TEETH AND NUMBER OF DMF PERMANENT TEETH PER HUNDRED CHILDREN FOR AGE AND SEX (4,416 CHILDREN, HAGERSTOWN, MD.)

	Age (Last Birthday)										
	6	7	8	9	10	11	12	13	14	15	All Ages
Boys											
No. of cases	171	197	231	253	270	262	299	267	199	83	2,232
DMF teeth	43	115	255	452	646	722	1,068	1,065	1,012	554	5,932
DMF teeth per hundred cases	25.1	58.4	110.4	178.6	239.2	275.6	357.2	398.9	508.5	667.5	
Girls											
No. of cases	156	206	256	240	259	269	297	278	165	58	2,184
DMF teeth	52	178	328	542	683	788	1,111	1,413	886	359	6,340
DMF teeth per hundred cases	33.3	86.4	128.1	225.8	263.7	292.9	374.1	508.3	537.0	619.0	

TABLE 2.—NUMBER OF CHILDREN, NUMBER OF DECAYED, MISSING AND FILLED (DMF) PERMANENT TOOTH SURFACES AND NUMBER OF DMF PERMANENT TOOTH SURFACES PER HUNDRED CHILDREN FOR AGE AND SEX (4,416 CHILDREN, HAGERSTOWN, MD.)

	Age (Last Birthday)										
	6	7	8	9	10	11	12	13	14	15	All Ages
Boys											
No. of cases	171	197	231	253	270	262	299	267	199	83	2,232
DMF surfaces	59	169	365	826	1,301	1,334	2,094	2,216	2,004	1,191	11,559
DMF surfaces per hundred cases	34.5	85.8	158.0	326.5	481.8	509.2	700.3	830.0	1,007.0	1,439.9	
Girls											
No. of cases	156	206	256	240	259	269	297	278	165	58	2,184
DMF surfaces	66	237	470	1,038	1,274	1,424	2,161	2,852	1,850	822	12,194
DMF surfaces per hundred cases	42.3	115.0	183.6	432.5	491.9	529.4	727.6	1,025.9	1,121.2	1,417.2	

in terms of both numbers of teeth attacked and numbers of surfaces involved.

However, in examining these relationships between the findings in the permanent and in the deciduous teeth, certain basic differences in the data collected relative to the caries experience in these two tooth groups must be kept in mind. Since loss (extraction) of permanent teeth in children may be considered the result of advanced caries, the complete caries experience (decayed, missing or filled teeth) for these teeth may be readily determined. On the other hand, the findings on the deciduous teeth represent only that caries experience (decayed or filled teeth) of the teeth present in the mouth at the time of the examinations, it being impossible to determine whether a missing deciduous tooth had been extracted as the result of caries or had been normally exfoliated. Further, an undetermined number of carious deciduous teeth about to be exfoliated cannot be considered as representing dental needs. For these reasons, and because it is evident that the initiation of the caries problem in deciduous teeth occurs largely in preschool children, further discussion of those dental needs represented by carious defects in the deciduous teeth must await more complete study.

The finding that the prevalence rate of dental defects in the permanent teeth, per hundred boys, increases from a low of twenty-five carious teeth with thirty-five defective surfaces at age 6, to 668 carious teeth with 1,435 defective surfaces at age 15, and that the rate for girls shows a similar age trend, affords quantitative evidence of the marked activity and seriousness of dental caries in grade-school children. Expressed somewhat differently: Only 16 per cent of children aged 6 had one or more carious permanent teeth; whereas, more than 96 per cent of those aged 15 had one or more carious permanent teeth.

The marked variations in the vulnerability of the different surfaces and teeth of the permanent dentition to attack by

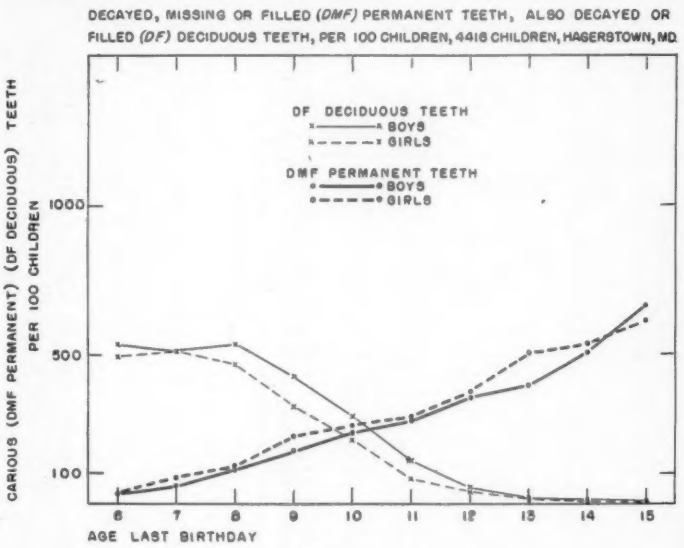

Figure 1.

TABLE 3.—NUMBER OF CHILDREN, NUMBER OF DECAYED AND FILLED (DF) DECIDUOUS TEETH AND NUMBER OF DF DECIDUOUS TEETH PER HUNDRED CHILDREN FOR AGE AND SEX (4,416 CHILDREN, HAGERSTOWN, MD.)

	Age (Last Birthday)										
	6	7	8	9	10	11	12	13	14	15	All Ages
Boys											
No. of cases	171	197	231	253	270	262	299	267	199	83	2,232
DF teeth	913	1,012	1,239	1,079	798	373	169	45	25	8	5,666
DF teeth per hundred cases	533.9	513.7	536.4	426.5	295.6	144.3	56.5	16.8	12.6	9.6	
Girls											
No. of cases	156	206	256	240	259	269	297	278	165	58	2,184
DF teeth	773	1,056	1,203	783	555	247	123	48	7	0	4,795
DF teeth per hundred cases	495.5	512.6	469.9	326.2	214.3	91.8	41.4	17.3	4.2	...	

TABLE 4.—NUMBER OF CHILDREN, NUMBER OF DECAYED AND FILLED (DF) DECIDUOUS TOOTH SURFACES AND NUMBER OF DF DECIDUOUS TOOTH SURFACES PER HUNDRED CHILDREN FOR AGE AND SEX (4,416 CHILDREN, HAGERSTOWN, MD.)

	Age (Last Birthday)										
	6	7	8	9	10	11	12	13	14	15	All Ages
Boys											
No. of cases	171	197	231	253	270	262	299	267	199	83	2,232
DF surfaces	1,866	2,080	2,714	2,324	1,653	746	350	105	61	25	11,924
DF surfaces per hundred cases	1,091.2	1,055.8	1,174.9	918.6	612.2	284.7	117.0	39.3	30.6	30.1	
Girls											
No. of cases	156	206	256	240	259	269	297	278	165	58	2,184
DF surfaces	1,441	2,200	2,659	1,609	1,136	550	299	109	13	0	10,016
DF surfaces per hundred cases	923.7	1,068.0	1,038.7	670.4	438.6	204.5	100.7	39.2	7.9	...	

caries are shown by the following findings: Forty-three per cent of all carious surfaces were occlusal, 17 per cent mesial, 14 per cent distal, 13 per cent buccal and 12 per cent lingual. Carious surfaces in lower first molars accounted for 87 per cent of the total caries in the lower jaw; while those found in the upper first molars constituted 65 per cent of the carious areas in the upper jaw. Roughly, two-thirds of the total number of carious teeth in the younger age groups, that is, ages 6 and 7, were lower teeth, but the proportion of carious teeth in the upper jaw increased with advancing age, so that, for ages 13 to 15, the proportions of carious teeth are approximately equal in the two jaw segments.

Findings on the loss of permanent teeth become of special interest from the viewpoint that tooth mortality in childhood bears somewhat the same relation to the problem of dental caries as specific death rates bear to the problem of other disease entities. In the children studied, tooth mortality rates, per hundred children, increased directly with chronologic age. For example, these rates for boys increased from 0 at age 6, to 118 at age 15. Of a total of 1,549 missing (extracted + roots) permanent teeth, 95 per cent were first molars and 75 per cent were lower first molars. In no age-sex group did the first molars alone account for less than 90 per cent of the total tooth mortality. These specific findings on tooth mortality, together with those on caries rates, single out the first permanent molar as the problem child of dental needs in grade school pupils.

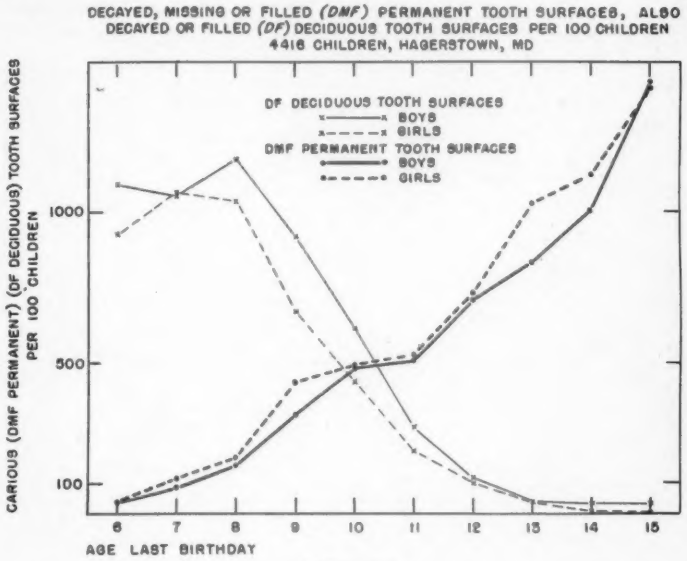

Figure 2.

WHAT CONSTITUTES DENTAL NEEDS

Since this discussion will be limited essentially to an examination of those dental needs of the Hagerstown children which are the result of caries in the permanent teeth, and since, for our purposes, needs become those professional services which may be administered for the care, control and prevention of dental caries, it would appear necessary to present our concept of the present status of knowledge of this disease. One of the

first theories to gain widespread acceptance as an explanation of the cause of dental caries was Miller's chemicoparasitic theory, which holds that dental caries is a chemicoparasitic phenomenon characterized by progressive decalcification of the enamel and chemical dissolution of the dentin and cementum. However, it is obvious that this theory is largely descriptive of the process. To date, the organism and conditions necessary to the process are not known.

At various stages in the study of dental caries, investigators have suggested that heredity, endocrinologic conditions, salivary components and other constitutional and physiologic factors play an important, but yet undetermined, rôle in the disease. Numerous dietitians have proposed theories, some of which have a widespread following today. One of the first of these was advanced by Pliny, the Roman sage, who said, "If one wishes to be free of toothache, one should eat a whole mouse twice a month." However, modern dietary concepts are more esthetic and have such varied and well-known factors as the calcium-phosphorus ratio; vitamins A, C and D; prenatal diet; physical consistency of the diet; excess carbohydrates; the dietary effect on enzyme inhibitors in the saliva, and fluorine and other components of the water supply. But these are as yet essentially theoretical considerations, and although there is evidence that a strict dietary regimen may operate somewhat to reduce the incidence of this disease, we must keep in mind that diet and nutrition apparently bear a relationship of varying importance to most of the known chronic diseases, even those for which the specific causative agent has been determined; such as tuberculosis.

TOOTH MORTALITY RATES, PER 100 BOYS, FOR THE PERMANENT TEETH OF 1127 BOYS WITHOUT FILLINGS AND 440 BOYS WITH FILLINGS. HAGERSTOWN, MD.

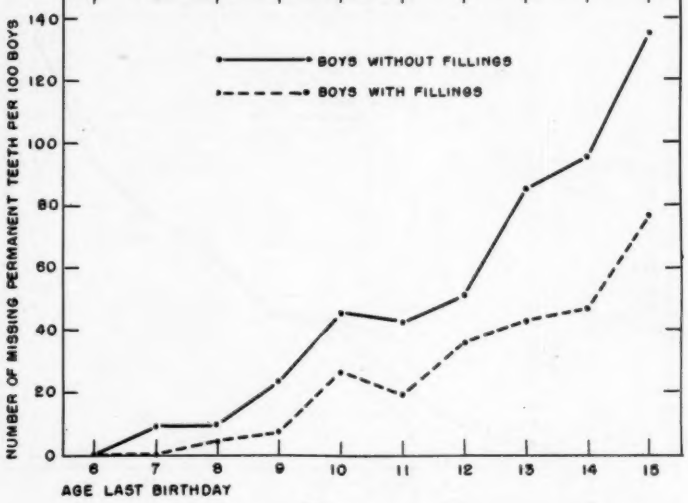

Figure 3.

Since it must be concluded that we do not yet know the cause of dental caries and that relatively little can be done from a public health standpoint to prevent attack of the teeth, our next important approach to the problem becomes a consideration of methods for preventing tooth loss and other serious

TABLE 5.—NUMBER OF PERMANENT TEETH MISSING AND TOOTH LOSS RATES FOR 1,127 BOYS WITHOUT FILLINGS AND 440 BOYS WITH FILLINGS (1,567 BOYS, HAGERSTOWN, MD.)

	Age (Last Birthday)											
	6	7	8	9	10	11	12	13	14	15	All Ages
Without Fillings											
No. of cases	19	55	94	142	164	150	174	143	124	62	1,127
Teeth missing	0	5	9	33	75	64	89	122	118	84	599
Teeth missing per hundred cases	...	9.1	9.6	23.2	45.7	42.7	51.2	85.3	95.2	135.5	53.2
With Fillings											
No. of cases	2	2	22	32	49	68	89	86	64	26	440
Teeth missing	0	0	1	2	13	13	32	37	30	20	148
Teeth missing per hundred cases	...	...	4.6	6.3	26.5	19.1	36.0	43.0	46.9	76.9	33.6

sequelae of dental caries. Through prolonged use and the test of time, the treatment of early carious lesions by the proper placement of chemically and physically stable filling materials has become established and accepted as the best known means of interrupting the usual course of the carious process and preventing caries of the teeth from terminating in tooth loss. On the basis of this premise, it appeared that a comparison of the tooth mortality rates of the Hagerstown children having fillings as evidence of past treatment of one or more carious defects, with those rates for children having no objective evidence of such treatment, should reveal the manner in which fillings affect the characteristic of tooth mortality. This comparison indicated that children having fillings had a significantly lower tooth loss for each age-sex group than had children with no fillings. For example, boys without fillings, over all ages, had roughly 60 per cent more missing permanent teeth than boys with fillings. (Table 5; Fig 3.)

ESTIMATING DENTAL NEEDS

On the basis of the foregoing, we are compelled to approach the problem of dental needs from the viewpoint that although we can do relatively little to prevent dental caries, we *can* prevent tooth loss. It appears, therefore, that primary control efforts should be directed toward the development and promotion of procedures whereby the early detection and filling of carious teeth are accomplished and tooth loss is thereby prevented. This approach directs attention toward a determination of that annual rate of caries attack of the permanent teeth which would result in the finding of 24,000 accumulated defective surfaces in the 4,416 Hagerstown children studied. Since the defects resulting from caries in the permanent teeth are cumulative with age, caries in the permanent teeth of children 6 years of age

TABLE 6.—DATA FOR CALCULATION OF INCREMENT OF NEW CARIOUS SURFACES WHICH MAY BE EXPECTED ANNUALLY IN PERMANENT TEETH OF 4,416 ELEMENTARY SCHOOL CHILDREN IN HAGERSTOWN, MD.

	Age (Last Birthday)										
	6	7	8	9	10	11	12	13	14	15	All Ages
Number of Children											
Boys	171	197	231	253	270	262	299	267	199	83	2,232
Girls	156	206	256	240	259	269	297	278	165	58	2,184
Observed Number of Decayed, Missing or Filled Surfaces per Hundred Children											
Boys	34.5	85.8	158.0	326.5	481.8	509.2	700.3	830.0	1,007.0	1,434.9	
Girls	42.3	115.0	183.6	432.5	491.9	529.4	727.6	1,025.9	1.121.2	1,417.2	
Difference Between Age Specified and Previous Age in Observed Number of Decayed, Missing or Filled Surfaces per Hundred Children											
Boys	34.5	51.3	72.2	168.5	155.4	27.3	191.1	129.7	177.0	427.9	
Girls	42.3	72.7	68.6	248.9	59.4	37.5	198.2	298.3	95.3	296.0	
Expected Number of New Carious Surfaces Between Age Specified and Previous Age*											
Boys	59.0	101.1	166.8	426.3	419.6	71.5	571.4	346.3	352.2	355.2	2,869
Girls	66.0	149.8	175.6	597.4	153.8	100.9	588.7	829.3	157.2	171.7	2,990

*Items tabulated directly above times number children in respective age groups.

were viewed as an accumulation of defects which had been added each year up to age 6. Carious defects at 7 years of age were considered equal to those which had accumulated at age 6 plus the increment of new defects which appeared between the sixth and seventh years of age. In this manner, a total yearly increment of defects for the entire elementary school population was calculated as the sum of the annual increments for each age-sex group from 6 through 15 years. The results of this procedure indicated that 5,859 carious tooth surfaces represented the estimated increment of new defects in the permanent teeth which may be expected to appear each year in those 4,416 grade-school children. (Table 6.)

This annual increment of nearly 6,000 defective permanent tooth surfaces may be viewed, therefore, as the annual endemic caries attack rate for this particular segment of the population of Hagerstown. Translated into professional service requirements, it was estimated that somewhat less than 10 per cent[8] of the professional facilities of this community with thirty-two practicing dentists would be required to supply complete dental care for this annual increment of defects. In this connection, it is of interest that an analysis of data on fillings present at the time of the examinations indicated that less than 2 per cent of the professional facilities of the community had been expended annually in the care of defects in the permanent teeth of these children, and therefore these defects were accumulating about six times as fast as they were being cared for.

This quantitation of the disparity between the rate of development of defects and the rate of placement of fillings rather pointedly summarizes the dental needs of the Hagerstown grade-school children arising from carious defects in the permanent teeth.

CONCLUSION

In conclusion, it is recognized that the quantitation of dental needs is merely an introduction to the far more difficult problem of supplying those needs; a problem which, from the standpoint of the lay public, involves such factors as education directed toward an appreciation of dental health, creation of a demand for proper and adequate dental services, the motivation and development of correct dental habits in children, willingness to pay equitable fees for children's dentistry and acceptance of the social and economic responsibility of caring for the dental needs of the indigent members of the community; a problem which, from the standpoint of the dental profession, involves such factors as greater emphasis on the teaching of the technics and patient psychology of children's dentistry, in both undergraduate and postgraduate education, adequate remuneration for children's dentistry, acceptance of the responsibility for developing methods whereby the huge gap between dental needs and dental services may be eliminated and, finally, the adoption and application of a truly preventive dental approach to the diseases of the teeth, with the responsibility for which the profession is charged.

This modern concept of preventive dentistry, in practice, must consist of service directed toward maintaining the health and increasing the life expectancy of teeth. It must look upon extraction as the mortician service that it actually is. It must consider the replacement of teeth by bridges and prosthetic appliances as equivalent in a sense to a commemorative or tombstone service to deceased and lost teeth.

Although we are all more or less qualitatively familiar with the gravity of the problem of dental needs, it is obvious that its solution is difficult, if not impossible, without access to an examina-

*Items tabulated directly above times number children in respective age groups.

tion of its objective aspects through records and accurate data. Furthermore, quantitative facts instead of impressions must be employed that we may evaluate the progress and relative merits of our various attempts at solving this problem; a problem which largely resolves itself into one of so redistributing the dental services in the chronologic age scale of the human population that, through proper and adequate dental care at the most effective age, youth, less may be required for the dentally healthier adult of the future.

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2. Details on which this estimate is based are presented in Klein, Palmer and Knutson, Reference 2.

PRACTICAL APPLICATIONS OF CROWN AND INLAY CASTING TECHNICS

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FOR more than thirty years, dentists have worked constantly to improve the technic of casting. The first great improvement came in the form of thermal expansion of wax to compensate for the assumed 1.25 per cent shrinkage of gold. Van Horn, Coy and others perfected this technic to the utmost of its possibilities, considering the characteristics of the materials involved. More recently, the expanding investment materials have been added; and it seems to me that the next logical step forward is a correlation in the minds of all dentists of the information given us by our own untiring workers and those in the National Bureau of Standards. We might then more intelligently apply those facts a knowledge of which helps us in the control of dimensional changes occurring in the casting process.

It is well in the beginning to dispel the belief that any one technic can be a panacea. This is only one of the numerous erroneous ideas on casting that are widespread in the profession. The chief of these is that shrinkage of gold is the only major problem in the control of variables in casting. Another is the idea that a well-fitting casting on a laboratory demonstration model will always have equally fine results in the mouth. We have also been bombarded from all sides

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with the theory that the amount of expansion necessary in any case depends on the size and shape of the wax pattern. I shall here describe some experiments in the making of wax patterns and their investment and casting which have led me conclusively to the opinion that size and form, which have been grossly overemphasized, are really of comparatively little importance. Wax is wax and gold is gold, and their characteristics remain almost the same no matter what form either is molded into or how large the mass is. But since any discrepancy in the finished casting will be magnified directly in proportion to the size of the mass, the technic must be much more exacting for the larger castings. It is well to remember, however, that smaller castings made under similar conditions also need a certain amount of expansion, unless the minute space-filling material called cement is taken into consideration.

In order that no one may misconstrue the statements just made, I wish to state here that patterns of different types may require different degrees of expansion. For example, the three-quarter crown usually requires the least and an occlusal inlay the most, but this, as we shall see later, is due more to the temperature at which the patterns are made than to the size or shape of the patterns themselves. This is important; for if we depend only on the type of a pattern to establish a technic, a casting may be much too tight or too large.

One of the most important considerations in the casting problem is the personal equation. This includes one's conception of present-day standards, the ability to detect imperfections, a desire to improve technic, the choice of materials and the way in which they are used. Dentists must develop their powers of observation. Recently, Honess Lee said:

> Men not only need to know what to look for, but they have to learn what to see. The things with which people are surrounded become so much a part of their daily lives that unless they are wide awake, both mentally and spiritually, they accept them as final and complete, and incapable or unworthy of further development.

How often we see a large, beautiful inlay and exclaim, "Perfection!" We have all seen them; but, upon exploring at the gingival margin, we may find a ledge of enamel protruding beyond the inlay. Are we willing to accept the fact that such an inlay is more apt to break a tooth and to be uncomfortable and hazardous than one which was allowed to expand more? Are we willing to change our technic from the one which made the "beautiful" inlay? We must not stop at what we sometimes think is perfection, but rather must strive toward what is really nearer perfection. Many of us believe that the perfect inlay has not yet been made.

In describing the casting problem, it is easy to illustrate by figures the action of waxes and investments, but the in-

Shrinkage on Varying Conditions

Adaptation Temperature	Laboratory Temperature (Degrees F.)	Percentage of Shrinkage* In Wax		In Gold		Total
105	cooling to 75 (30 cooling) gives	0.75	+	1.25	=	2.00
95	cooling to 75 (20 cooling) gives	0.50	+	1.25	=	1.75
95	cooling to 85 (10 cooling) gives	0.25	+	1.25	=	1.50
95	staying at 95 (no change) gives	0.00	+	1.25	=	1.25
95	rising to 105 (10 rise) gives	0.25	expansion	1.25	=	1.00

*Indirect patterns (no wax shrinkage or expansion) give 1.25 total shrinkage.

fluence of the personal equation cannot be thus recorded. This phase must be controlled by each operator according to his own observations and deductions. If he does not observe clearly, he cannot control this aspect of his work intelligently.

Van Horn has repeatedly reminded us that a wax pattern is made at mouth temperature, which is usually not the same as room temperature. He points out that most wax patterns are fitted to the cavity at approximately 95° F. Phillips used mouth temperature when working out his simple graphs which so vividly illustrate the casting problem as it is today. It is impossible, however, to make all patterns an exact counterpart of a cavity at mouth temperature. The occlusal inlay is an example of this. Also, it is possible, in some cases, to adapt a wax pattern, such as the anterior three-quarters crown, to fit at a temperature lower than that of the mouth. Another example is the pattern made at room temperature, as all indirect patterns are. Therefore, it would seem advisable to supplement the term "mouth temperature" with that of "adaptation temperature," as used by Taylor and Paffenbarger, because it is a variable which may range anywhere from about 70 to 110° F. This is important because, as Van Horn and Phillips have shown, it is the change from "adaptation temperature" to room temperature which alters the size of a wax pattern. This change may vary from zero to as much as 1.2 per cent, because wax shrinks or expands 0.025 to 0.04 per cent for each degree Fahrenheit change in temperature. Therefore, the following equation should illustrate the problem of dimensional change in casting and its control: adaptation temperature minus investing temperature equals temperature change. This multiplied by 0.025 per cent equals wax shrinkage, which, when added to gold shrinkage, equals the amount of expansion required.

The accompanying table, which is a slight variation from that used by Phillips, illustrates what happens to wax patterns as they are made under varying conditions.

The figures given in the table show that the dimensional compensation requirement is sometimes 2 per cent or more, and that the shrinkage of gold is not the only consideration; also, the operator should be able to apply the technic so that it will fulfil the need in any particular case. In other words, the dentist, for the best results possible according to modern methods, must so carry out the investing and casting that he will cast into a mold which is regulated in size to suit the case at hand, using an amount of expansion anywhere between 1 and 2 per cent. The size of a wax pattern changes from day to day, even from hour to hour, and varies directly with the change of temperature of the laboratory.

Therefore, the casting problem is not necessarily to reproduce exactly a wax pattern as we have it in our laboratory, because the pattern may be smaller than the original cavity or it may even be larger. The real problem is to control the mold dimensions in order that the casting shall be large enough to compensate for the gold shrinkage plus or minus any change in size of the wax pattern.

Can it be done? The answer is that it can be done with a satisfactory degree of success with several of the investment materials on the market, if they are manipulated properly. It must be stated, however, that often manipulation is not correctly carried out. The main reason is to be found in the directions that appear on the outside of the containers of commercial investment materials, directions which, though definitely an aid to the dentist, are very much in need of additions and alterations.

Investment materials will be discussed here in the order of their apparent pop-

ularity, which places the so-called high heat investment first. No. 1, which, by the way, does produce very fine castings, is described as being capable of two different degrees of expansion. That is, a thin mixture will give a total setting and thermal expansion of 1.14 per cent; a thick mixture, a total of 1.30 per cent, when casting is done at 1400° F. If it will do this, the thin mixture can be used to cast direct patterns during the summer days when the laboratory temperature reaches 105° F.; the thick mixture, for all indirect models and direct models when the laboratory temperature is 95° F. Beyond these conditions, although this investment can be used, it is not in itself able to meet all requirements as an expanding investment. Its use must be combined with another method known as the thermal expansion of wax. That is, if a pattern, on being removed from the mouth to the laboratory, cools down to 75°, the water bath or other means must be employed to bring it back to 95°, as the investment sets around it. This is necessary because this investment can compensate by its so-called thick mixture for 1.30 per cent shrinkage, which is only slightly more than the contraction of gold, so that no wax shrinkage in addition to gold shrinkage can be compensated for.

No. 2 investment material is similar to No. 1 in that it is of the so-called high heat type. The manufacturer of No. 2 claims for it a total expansion of 1.37 per cent when a mixture is made according to stipulations as to amount of water and investment material. A thicker mixture, it is stated, will give a total expansion of 1.45 per cent. Goldberg has found the true figures to be considerably less. The manufacturer's directions in this case list the various types of wax models which may be cast with each amount of expansion. By using No. 2 investment, very fine castings can be made. All crown and inlay patterns which are made on a die are within its range of expansion. Direct patterns which are subjected to a laboratory temperature lower than the adaptation temperature will, however, produce castings which are too small unless a water bath is used. Slightly more expansion can be had by dusting investment powder on the invested pattern, thereby creating a so-called thick inner investment.

In reference to the directions given on the container of No. 2 investment, it is erroneous even to suggest that either mixture will satisfactorily cast a particular type of pattern if the conditions under which the pattern was made are totally disregarded.

Investment No. 3 is the superexpanding type which, in itself, will give a total setting and thermal expansion of approximately 1.60 per cent (Goldberg). When this material was first introduced, it was lauded in all quarters, but, since then, it has been much misused and has even been discarded by many dentists. This investment is not complete in itself, as it depends on a second investment of lower expanding qualities, to be used in combination with it. This second material is a control powder used to diminish thermal expansion. The two are mixed in varying proportion; as the control powder portion increases, the thermal expansion decreases. The chief advantage of this investment is the fact that the expansion range is greater and can be controlled more easily than is the case with other materials.

In using No. 3 investment, I have found it advantageous to substitute a silax, graphite investment for the manufacturer's control powder. In this combination and with a good proportioning scale, this technic for obtaining the desired amount of mold expansion is very satisfactory. When the adaptation and investing temperatures vary more than 15 degrees, it becomes necessary to use some thermal wax expansion. Also, for those castings requiring little expansion, care must be exercised not to overexpand.

With all this information at hand, I was still at a loss to know why the profession seemingly had accepted the idea that the amount of expansion necessary in each case is determined almost entirely by the type and size of the pattern. I therefore conducted some experiments by means of photography. Cavities, wax patterns at different temperatures and castings were photographed, identical photographic conditions being used in each case; i.e., the camera was always focused and set at the same distance from the object. The recorded images were then projected upon a screen, each casting a shadow many hundred times its actual size. Each shadow could then be measured accurately and the differences in size be determined.

Three types of patterns, the three-quarter crown, the occlusal inlay and the full crown, were used for this experiment. The results, although difficult to record in exact figures, revealed important points in each case. Occlusal inlay patterns were made under great pressure, this pressure being exerted until cavities and patterns reached 95° F., or approximately mouth temperature. The patterns were then invested at room temperature, 80° F. Expansion was calculated to compensate for gold shrinkage plus shrinkage of wax when cooled 15 degrees F. The patterns were photographed at 95° F. and at 80° F. The castings were also photographed. This experiment proved the castings to be larger than the patterns at investing temperature and about the same size as the patterns at 95° F. This, in turn, proves that the investment gives the desired amount of expansion, but, as usual, most of the inlays were too small for the cavities. The fact that these inlays are often too small is due not to a failure of the expanding investments to give their normal amount of expansion, but to the fact that the occlusal inlay pattern, when removed, is always smaller than the cavity in which it was made. This is because the wax congeals at approximately 105° F. and shrinks as it reaches mouth temperature. In this case, the adaptation temperature is approximately 105°, not 95° F. Ten degrees thermal expansion of wax in addition to the expansion used in the experiment assured well-fitting castings.

Experiments on the three-quarter crown pattern and castings likewise had interesting results. It was found that the mold of this pattern does not, when heated, go through any peculiar contortions which result in too large a crown. Calculating the amount of expansion necessary according to the equation in the table assures a satisfactory crown. It must be remembered that a three-quarter crown pattern is usually made at room temperature on a die, and therefore requires only enough expansion to compensate for the shrinkage of gold. Direct patterns of this type, because they are thin around the tooth rather than within a cavity, and near the front of the mouth, where the margins can be more easily manipulated, are also adapted at a lower temperature than are most other direct patterns. The existing tradition about this type of pattern is due to miscalculation of the amount of expansion necessary for any pattern made under like conditions, and not to its particular shape. Also, overexpansion is more hazardous in this type of restoration than in any other, and we consciously fear it.

Experiments on the full crown proved no exception to the principles already established. When full crown patterns were invested and cast under the same conditions as those governing the investment and casting of the occlusal inlay and the three-quarter crowns, the percentages of expansion and contraction were approximately the same. Why, then, do so many clinicians and manufacturers alike advocate much more expansion for the full crown than for the other types? The answer is that, in any resto-

ration, many irregularities occur from the beginning of the preparation to the finished casting. Compound impressions shrink; dies shrink or expand, and there is some warpage in every casting. Since the full crown is the most extensive of all restorations, it is the one most affected by these irregularities. And because the full crown is the most rigid of all castings, it will not go to place unless expanded enough to circumscribe the prepared tooth plus all the irregularities.

From these experiments, I have concluded that if dentists are to improve the casting technic, they must base their labors upon facts rather than upon types, shapes and sizes of wax patterns.

A few other factors in our equation in calculating the required amount of expansion in the casting process are the cavity or tooth preparation, the method of adapting the wax, the method and materials used in making indirect impressions, the die materials, the dentist's ability to estimate the adaptation temperature of wax patterns and the method of applying investments to the wax pattern. The effect of the last-named factor on the amount of setting expansion is described by Scheu. These factors can be of such magnitude that alteration of the amount of mold expansion may be necessary to compensation. An investing and casting technic which is theoretically correct should be adopted by every dentist. Then the conditions and method of procedure for each casting should be recorded in writing. In other words, some original research and experimentation should be conducted in every dental laboratory. If castings do not then fit so well as is desired, it is still possible to study the exact technic used for each casting and to make necessary changes on the basis of one's observations. For example, if an amalgam die is used, more mold expansion is necessary; if a hydrocol die is used, less expansion may be needed.

In conclusion, it may be said that the technic of investing and casting has not yet reached the stage of an exact science. The many factors involved demand the intelligent observation of every dentist. He must visualize the desired end-result and must know the limitations and the changes which take place in the materials he uses, and how to control them. The possibilities of investing and casting procedures have been vastly increased of late years, and, as this has occurred, the process has become more complicated, requiring a more masterful hand.

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SOME CONTROVERSIES OVER THE TEMPOROMANDIBULAR JOINT

By L. B. Higley, B.A., D.D.S., M.S., Iowa City, Iowa

EVEN a cursory perusal of the literature concerning the temporomandibular joint reveals conflicting ideas and statements relative to certain fundamental considerations such as are discussed in the following paragraphs.

MANNER OF DEVELOPMENT

Representative of those working in the field, McCollum[1] believes that the temporomandibular joint takes its permanent form by the age of 10 or earlier, and that the joint and the tooth form and arrangement develop separately, but that joint and tooth should come together with the proper form at the correct time. Riesner,[2] on the other hand, comments that development is not complete until 25 years of age and that the joint develops simultaneously with the dentures, the form of the mandibular fossa being subject to function and to cusp formation.

COMPENSATORY OR ADAPTIVE CHANGES IN THE JOINT

McLean,[3] McCollum and others further believe that this joint, once it reaches adult form, is not amenable to change. They base their contention on the argument that the joints are the most stable structures of the body, stating further that if the arrangement of the cusps of the teeth compels the mandible to protrude in cuspal interdigitation, the temporomandibular joint will not change to meet the condition. The teeth will remain out of centric position to the detriment of the investing tissues and, in some unusual cases, to the detriment of the joints, because the muscles and ligaments are under constant strain. Thus, arthritis of the joints with clicking and often pain during chewing will result. Todd,[4] however, cites several examples in which a permanent relationship between condyle and articular eminence has been established by a shortness of the mandibular body due to growth defects, but he concludes that this entails no disability.

Riesner, by use of the roentgenogram in the living, and Harris,[5] by a study of cadavers, have demonstrated the ability of even the adult joint to adapt itself in an attempt to compensate for changes in the articulation of the teeth. Changes in the form of the glenoid fossa and the articular surface or neck of the condyle supposedly occur. Harris concludes:

> There is too much tendency to consider the mandible as an unyielding, unchanging, case hardened structure, as is evidenced by dentures constructed to habitual movements of the mandible and adherence to fixed condylar paths. . . . An alteration in the function and relation of the mandible to the maxilla has a decided effect on the normal functions in the glenoid fossa.

IMPORTANCE OF THE JOINT TO ARTICULATION

It has been repeatedly pointed out by

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McCollum[1, 6] that the articulation of the teeth is primarily dependent on the unchanging movements of the condyle, which are, in turn, dictated by the temporomandibular joints. If this is true, the question of joint stability becomes of paramount importance because, if the joint does not change, the movements of the condyle, which, he believes, it controls, may remain constant, but if the joint does change, certain changes might occur in the movements of the mandible and condyle.

Smith,[7] while using motion pictures to demonstrate a case in which both condyles had been removed with no seeming evidence of impaired mandibular function, implied in his comments that those prosthodontists who base their concept of articulation solely upon the condyle factors might have reason to pause and think when viewing the results obtained in this case. He undoubtedly implies that, although the condyles may be important when present, the muscles which control the mandibular movement are of the greatest significance. McCollum agrees that the direct opening and closing movements of the mandible in such cases of missing condyles seem quite natural, but he points out that the lateral and posterior movements are limited and that the attempts at chewing are a poor makeshift indeed.

Todd, in discussing the temporomandibular joint, assuredly seems to support the idea of the importance of the musculature when he states, "Mastication is, in its details, an individual problem to be worked out by the musculature in relation to limitation of opportunity by the bony formation." The limiting effect of the *eminentia articularis* on the action of the external pterygoid muscle will be called to the attention in the following discussion.

MUSCLES CONTROLLING MANDIBULAR MOVEMENT

Although the various authorities are in agreement concerning the muscles that control the closure of the mandible, many conflicting statements are found in both the textbooks and the literature relative to the muscles engaged in the depressing or opening movement. While Gray's Anatomy[8] states that "the mandible is depressed by its own weight assisted by the platysma and the suprahyoid muscles (mylohyoid, digastric and geniohyoid), Prentiss,[9] Lord,[10] Chissin,[11] Brodie[11] and others believe that the external pterygoid is the main muscle producing the opening movement. McCollum, in a personal communication, expressed the opinion that the external pterygoid is not a factor in opening the mouth at all, but that the movement is primarily the result of the action of the geniohyoid muscles.

Harris,[12] in response to a direct question relative to the action of the pterygoid muscle, replied as follows:

> I believe the primary function of the external pterygoid is to protrude the mandible. However, the anterior surface of the glenoid fossa down to and including the eminentia has a downward effect on the head of the condyle, and in cases where anterior teeth are present, the inclined plane of the lingual of the upper incisors likewise forces the body of the mandible downward, the amount being dependent upon the overbite.

Chissin calls attention to the fact that the articular eminence alters the course of the meniscus and upper head of the external pterygoid (sphenomeniscus muscle) so that "it constitutes a pulley around which these combined structures work." He also points out that there is no protrusive movement of the mandible during direct sagittal opening, but that the condyles start to move downward and forward immediately.

Brodie, in condemning the view that the suprahyoids are the important muscles in the opening of the mandible rather than the external pterygoids, states:

> This conception persists principally be-

cause these muscles (suprahyoids) appear to occupy the positions of greatest mechanical advantage for this function. This evidence is accepted in the face of contradictions of a functional nature.

He calls attention to some of these contradictions by asking the following questions*:

1. If the suprahyoid muscles were actually the depressors of the mandible, why does not the condyle remain in the fossa, or even go further dorsally when the mouth is opened?

The resultant action of the suprahyoids is downward and backward and would not account for the downward and forward movement of the condyles, since there is no protrusion of the mandible in straight sagittal opening.

2. In those cases in which paralysis strikes the masticating muscles on one side, why does the jaw in opening swing toward that side?

Since the suprahyoids are not affected, they should cause a straight sagittal opening with no side swing if there is no protrusion or action of the muscles of mastication in such movement of the mandible.

3. In an attempt to open the mouth against a resistance such as a chin strap, why does fatigue set in first in the joint rather than in the region of the floor of the mouth?

Fatigue always occurs in the muscles in which activity or contraction is most pronounced, which, in this case, would seem to indicate activity of the muscles of mastication rather than the suprahyoid group.

4. Why should such an important joint as the temporomandibular be controlled in closure by one nerve trunk and in opening by two or three others, since in all other joints of the body, protagonists and antagonists are under control of the same nerve?

The external pterygoid muscle has the same innervation as the muscles which authorities agree are concerned with closing the mandible.

If the external pterygoid is accepted as the important muscle in the opening movements of the mandible, the questions are rather easily disposed of, but if the suprahyoids are considered most important, any explanation is difficult.

MOVEMENT PATTERNS OF THE MANDIBLE AND CONDYLE

Regardless of whether the mandible is depressed mostly by its own weight, by muscular activity or by a combination of the two, the pattern of mandibular movement, especially that of the condyle, is important if the articulation of the teeth is to be based upon it.

Both the facebow and the roentgenogram have been used to study the movements of the mandible and condyle. Brodie gives a brief well-composed review of the technics and findings of Chissin, who employed the facebow, and of Hildebrand, who used roentgenography. Most investigators agree that, in straight sagittal opening, the menton and gonial angle swing downward and backward at first and then upward and backward, while the condyle moves downward and forward at first, passing the summit of the articular tubercle, and then glides forward and upward ventrally to the tubercle as complete opening is accomplished. Both the hinge and the gliding action of the condyle are demonstrated in this movement, but controversy arises over the possibility of either action taking place independently of the other.

Since certain investigators base the articulation of the teeth on the movements of the condyle, it becomes essential to their technic that these movements be determined on the individual patient and transferred to the articulator,

*The italicized statements express the author's idea of the reasoning which led Brodie to ask the questions.

to be incorporated as the most important factor in the articulation of the teeth. The Gnathological Society of Los Angeles, headed by McCollum, has, during the past thirteen years, developed an almost flawless technic wherein, by employing the facebow, they have obtained the various condyle movements, all of which can now be duplicated on an ingenious articulator of their own design.

McCollum says, however:

> The use of the facebow is of no value unless its caliper points are set on the hinge axis line. . . . None of the other condyle movements can be determined, defined or studied without first determining and making use of the hinge axis and mandibular centricity. The centric position of the mandible is merely the starting point for all the mandibular movements. No articulating instrument can possibly reproduce the movements of the mandible without accurately reproducing the hinge axis and mandibular centricity.

In locating the hinge axis, McCollum has the facebow rigidly and immovably attached to the mandible and has an arm carrying a horizontal pin placed in the temporomandibular region. The hinge axis can be definitely located, he states, by the simple process of having the patient drop the mouth open and then close it in a series of rhythmic movements while the mandible and condyles are in centric position.

No other investigator except Gray has mentioned that the mouth can be opened while the condyles remain in centric position. All have indicated that the condyle immediately changes position when the opening movement starts, basing their reasoning on the anatomic structure of the joint and on the action of the external pterygoid muscle. McCollum says:

> It is fallacious to believe that the heads of the condyles move forward immediately upon opening the mouth. Facebow tests show that the incisal opening is always at least one-half inch, and may be as much as an inch and one-half, before the condyles start forward. This is accomplished by the patient only in a conscious manner; reflexly, when you tell the patient to open his mouth, he automatically puts the jaw forward. This forward movement on one or both sides would destroy the possibility of locating the opening axis (hinge axis) or would cause the finding of a false axis.

Chissin, typical of other investigators, does not find the condyle heads remaining in a centric position, but summarizes his findings as follows:

> The contraction of the upper head of the external pterygoid (sphenomeniscus muscle) pulls the meniscus forward and, since this is fastened to the back of the condyle, causes the condyle to roll and come forward. This head seems to be the one that is principally concerned with the first phase of opening, while the strong downward and forward gliding of the second stage finds the lower head (external pterygoid proper) playing the major rôle.

No matter what may finally be proved regarding these movements of the condyle, it would seem that the Gnathological Society has developed an excellent technic and one that will always be of value, because, clinically, it has seemed adequate.

RELATION OF MUSCULATURE OF THE JOINT TO TOOTH ARRANGEMENT

Another point of controversy arises in consideration of whether it is possible for the action of the joint musculature to cause the teeth in the natural dentures to arrange and maintain themselves in harmony with all the factors of articulation. Naturally, this could only occur in the absence of deforming etiologic conditions or after their elimination.

McCollum[13] sees no reason to believe that muscular function could develop a correct slope of the occlusal plane, a curve of Spee or curve of Wilson, although he does think that there is reason to believe that Nature wants the teeth to be where they should be. But since, as

stated previously, the temporomandibular joint has, or so he believes, reached its adult form before the age of 10, after which it is not amenable to change, it follows that the cusps must be interrelated in harmony with the movements of the condyle as dictated by the joint.

However, on analyzing the natural dentures of even the most ideally normal child of about 10 years, there is usually found what appears to be a chaotic condition in contrast to the ideal articulation of an adult, and yet it is correct for the dental age. Then, somehow, out of this chaos, there emerges, under normal conditions, a set of natural dentures that complies with all of the rules of articulation as demonstrated in a perfected mechanical denture.

Now, it may be asked, what conditions other than genetic could be responsible for working out the original slope of the occlusal plane, curve of Spee, curve of Wilson, etc., when the teeth that are erupting finally meet during this change from the deciduous to the permanent dentition? Is it not reasonable to believe that it is the result of muscular function making effective the condylar factors of articulation as dictated by the temporomandibular joints? This would be especially true if these joints have, by this age, reached their definite adult form. The extent to which this is true determines largely the possibility of obtaining a satisfactory orthodontic result. McLean implies an affirmative answer to this question when, in addressing a group of orthodontists, he states, "If you reach a close approximation of coordinated occlusion and use retaining appliances which permit tooth movement within prescribed limits, masticatory function during retention will induce the teeth to settle into improved occlusal relationships."

OVERCLOSURE OF THE MANDIBLE

Certain other interesting controversies arise in the consideration of dysfunction of the temporomandibular joint, especially that resulting in overclosure of the mandible due to loss of vertical dimension. Goodfriend,[14] Riesner, Harris, Costen[15] and others contend that, in overclosure of the mandible, the condyle is forced upward and backward deep into the glenoid fossa, various changes in the form of the fossa and condyle and in muscular action resulting. These supposed adaptive changes have, as was previously stated, been contested by McCollum, who believes that such malformation of the joint may be of congenital origin.

Since, in physiologic rest position, the teeth are out of occlusion, it would follow that the only time in which the condyle would be thrust deep into the fossa, even upon loss of vertical dimension, is during mastication, deglutition or other acts in which the mandible is closed. It may be questioned whether this is sufficient to produce these adaptive changes. Harris estimates that the mandible is closed about twelve out of the twenty-four hours.

Coincidentally with these supposed adaptive changes in the joint, Goodfriend, Costen and others report a group of pain and other symptoms associated with overclosure of the mandible. The entire syndrome described by Costen, including neuralgia, headache and ear symptoms, especially those associated with pain, or of nervous origin, has been questioned by Chor,[16] who contends that "the relating of such symptoms to disturbances of the temporomandibular joint has been mostly conjecture and the tests used to eliminate other etiologic factors as the cause have not been acceptable in many instances." However, the excellent clinical results obtained by the restoration of lost vertical dimension reported by Costen seem sufficient to justify the treatment. This will remain true, however, only in those cases in which acceptable tests are made to establish correctly the etiology, and in

which careful posttreatment records are kept to prove a permanent result.

That the restoration of lost vertical dimension is questioned by dentists as a universally acceptable treatment has been demonstrated in the last few years by the numerous articles appearing in the literature condemning the practice. McCollum, for example, states:

> Much has been written about excessive over-bite, which is the most common feature of malocclusion. Its ominous presence has well served operators to emphasize the "opening of the bite," the therapeutic importance of which has been greatly overstressed. In fact, so many atrocities have been committed under the supervision of "open-bite" advocates that the less said about bite opening the better.

If atrocities are being committed by the profession by bite opening, it is well that much more be said and that investigation be promoted to determine both its therapeutic value and the reason that the procedure, in certain cases, results in failure.

That beneficial results from bite opening are possible has been demonstrated, and failure is undoubtedly primarily due to incorrect diagnosis. Overclosure of the mandible due to loss of tooth substance in the posterior region has often been confused with the presence of an exaggerated curve of Spee, overeruption of the anterior teeth or lack of eruption of the posterior teeth, because any of these conditions may result in a similar picture of overbite of the incisor teeth.

If the majority of the symptoms associated with overclosure of the mandible are supposedly due to impingement upon nerves or other structures resulting from the upward and backward thrust of the condyle, in a case in which overclosure is the suspected cause, it becomes essential to determine whether such malposition of the condyle exists. If it does not, the case is one of overbite rather than of overclosure and must be due to incorrect correlation of the factors of articulation within the dentures themselves, or possibly to deformity of the maxillae or mandible. Under such conditions, opening of the bite is not indicated, but a rearrangement of the parts of the dental mechanism to correlate the factors of articulation is in order. If, on the other hand, the condyle is found to be in an upward and backward relationship in the glenoid fossa, restoration of lost vertical dimension to bring about a correct condyle-fossa relationship is indicated.

As an aid to diagnosis, a roentgenogram of the joint area seems indispensable, since it is the only means of determining the relation of the condyle to the glenoid fossa before and after treatment. However, if the roentgenogram is to be of value in this respect, two requirements are essential:

1. That a clear, well-defined roentgenogram be obtained, not of the condyle or the fossa alone, but of both, so that the relationship of the one to the other can be easily determined. To do this, a correct orientation of the subject to the path of the midcentral ray and to the film must exist, in order to aline the angles of the joint as accurately as is necessary.

2. That duplication of the position of the patient be possible for all subsequent exposures, so that the resulting roentgenograms can be relied on to show any change in the relationship of the condyle to the fossa.

A technic for producing roentgenograms that meet the foregoing requirements has been published in previous articles.[17] In the technic, a head positioner for holding and orienting the head and a casette holder for positioning the film in the correct relationship to the subject and x-ray tube are used. Recently, Speidel and Maxon[18] reported on the reliability of the method for orienting subjects. They found that, in 75 per cent of cases, the operator is able to reposition subjects with less than 2 mm. vertical and horizontal deviations from

the original position. They conclude: "It is felt that the extent to which accurate repositioning of the subjects can be accomplished is indicative of the reliability of the technic since the tube location is constant and the film is positioned mechanically." The study of some additional problems now under way would indicate that this roentgenographic method may contribute some evidence concerning the condyle-fossa relationships in various positions of the mandible where before there has been only supposition.

If, as believed by many, the temporomandibular joint is of great importance to the articulation of the teeth, the health of the dental mechanism and the symptoms associated with its dysfunction, it would seem necessary that agreement be reached concerning, at least, the fundamental controversies herein presented. This must be accomplished by careful investigation and by willingness on the part of all to substitute experimental evidence for opinion.

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CLEFT-PALATE AND CLEFT-LIP

By William L. Shearer, M.D., D.D.S., Omaha, Nebr.

I SHALL not relate in detail the anatomy of the palate, cleft and normal, but I shall try to point out the deviations observed in the cleft.

The face is in progress of development in the human embryo from about the third week. From the front of the cephalic mass, five tubercles bud, of which the middle one passes vertically downward. The middle tubercle is double, and in it the intermaxillary bones, which contain the incisor teeth, are developed. From this fact, it is termed the "incisive tubercle."

The rudimentary maxillary bones, which are widely separated, are developed at each side of the incisive tubercle, but are not united with it. The fourth and fifth tubercles are separated in front and subsequently are united in the median line to form the mandible.

At the same time, the palate begins to be formed, by the approach toward the median line of the two horizontal plates, developing from the maxillary processes on each side. If the palatal processes of the maxilla unite in the median line and blend also with the incisive bones, and the vomer grows downward to meet the palatal processes in their line of union, the upper lip and jaw will be normal. If, however, the maxillary and the intermaxillary processes fail to unite, cleft-lip and cleft-palate in one of their many forms will be the result.

I wish to point out the cause of the deformity in question and to describe a practice as advised by the late Truman W. Brophy, after many years of experience in his hands, and also, later, by me, by which the defect can be overcome at a time of life when it can be corrected most successfully and easily.

A great deal has been written on the causes of cleft-palate, much of which has been largely theoretical. When we review the literature, we find a great similarity of views among many writers. Imperfect nutrition during the early months of gestation is given as one of the causes. Heredity and prenatal impressions are given as other causes.

The condition of the mouth of a child who has a congenital cleft-palate is described thus: "Want of coaptation, resulting from defective formation in the palatine plates of the maxillary and palate bones, is the cause of congenital deficiencies of the parts in question." Again: "The palate plates are arrested in their growth and permanent fissure of the palate is the result. The principal effects from an absence of a portion of the palatine organs are an impairment of the functions of mastication, deglutition and speech." The definition generally given for cleft-palate is: "A congenital deformity characterized by a fissure or fissures of the palate, due to arrested development."

In the foregoing quotations, we find the general opinion that congenital cleft-palate is the result of incomplete development of the tissue necessary for its complete formation. The opinions thus expressed have been based, no doubt, on observations of the open space between the oral and nasal cavities.

I agree with Dr. Brophy that the deformity is not the result of "defective

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formation in the palatine plates," "congenital deficiencies of the parts in question," "arrested growth of the palate" or "absence of a portion of the palatine tissue." Children who have congenital cleft-palate have, with rare exceptions, the normal amount of tissue in the palate, although it is not united in the median line: it is a cleft.

Congenital cleft-palate has a predisposing and an exciting cause. The predisposing cause is heredity. The exciting cause is mechanical, the application of force in embryo. I have little faith in the theory that prenatal impressions cause failure of union of the bones in question. In the greater number of cases in which this cause has been given, it has been found that the mental shock occurred subsequently to the time when, if the physiologic processes were not interfered with, union of the bones would be complete. It is apparent that a mental impression could not separate a suture. Prenatal impressions may possibly be a factor in failure of union, but we have no authentic evidence to that effect.

I believe, however, that defective nutrition or general debility of the mother during the early months of gestation from any cause may delay union of the palatal plates. Nature does not fail to develop the necessary bone and soft parts to form a normal palate, but it does fail to bring the parts into apposition and unite them.

The bones having failed to unite prior to the fifth month of intrauterine life, the mandible, as soon as the muscles of mastication become active, brings pressure on the palato-alveolar inclined planes of the ununited superior maxillary bones, and, acting as a wedge, forces them apart and widens the breach. Moreover, the pressure of the tongue and the flexed position of the head, with the symphysis of the mandible resting on the sternum, may contribute to some extent to the force which is exerted by the lower jaw on the palatal arch and which results in separation of the bones.

Having operated on more than 2,000 cleft-palate patients, about 600 of whom were babies under 6 months of age, I have found that the upper jaw, as compared with the lower, is just as much broader than it should be as the distance between the borders of the fissure. When we bring the borders of the fissure into contact, we have brought the upper jaw back to its normal breadth and to its normal relation with the lower jaw. There are few exceptions to this statement, which was made by Dr. Brophy many years ago, and with which I agree.

In young infants who have cleft-palate, I have always found that slight forcing of the chin upward will cause pressure of the lower jaw against the segments of the upper jaw, springing the cleft bones apart.

Writers who have given a great deal of thought to the subject, who have dwelt at great length on its etiology and who have proposed the more generous use of phosphatic food for the mother during the period of gestation have been unconscious of the fact that the bones are not, as a rule, defective in structure or incomplete in development. There is only failure of union.

I have had five or six cases, however, in which there apparently was a lack of tissue, but the condition has been so rare in my practice as to be almost negligible.

Pediatric care is of great importance in these cases. These children should be placed in the hands of a well-trained pediatrician immediately. Every one of these cases is primarily a pediatric problem, and the mortality rate can certainly be greatly reduced if they are cared for by a competent pediatrician before and during surgical treatment. Many times, before different societies, I have made this plea, and today I make the plea stronger than ever.

Medical Arts Building.

SYPHILIS—THE DENTIST'S CONTACT WITH IT

By TRIM HOUSTON, Corsicana, Texas

THE saying "Where ignorance is bliss, 'tis folly to be wise" would, by the dentist familiar with the indications of congenital syphilis in children and young adults, at times be acknowledged as true. His recognition of these symptoms does place on him additional responsibility at times—a responsibility sometimes impractical of being discharged.

After the crises of infancy and young childhood come those of puberty and young adult life. The strains on both the physical and the nervous system from the rapid growth and development of puberty give syphilis a chance to manifest itself. Also, the additional nervous and physical burdens of early adult life: hard study, the first pregnancy, extra business or social obligations, "the indiscretions of youth," will, any or all, have the same results.

The infection and the damage it has done are there, hidden, waiting for the patient's resistance to be lowered to such an extent that the condition can manifest itself.

Many times, the dentist can, in calling the physician's attention to these indications, suggest the proper care of these cases. Unfortunately, there are times when the only sensible thing for him to do is to keep silent, particularly if he does not know the physician well enough to be sure that he has not only the ability to care for the case, but also, and just as important, the integrity to keep his counsel as to the source of his information. One such experience is sufficient.

CASE HISTORIES

A brilliant, ambitious 20-year-old university student, with mulberry first molars and screw-driver upper central incisors, presented himself for an oral examination. The patient was on the verge of a breakdown. The physician's attention was called to these indications of congenital syphilis and the patient was given iodides well disguised as a tonic. He was ready to resume his studies at the end of summer vacation.

A boy, previously normal, at puberty developed nervous indigestion and headaches. He was referred for a checkup as to the oral condition. The mouth was perfect, but there was a decided symmetrical swelling of the middle joints of the fingers. Antisyphilitic treatment relieved the conditions.

A 9-year-old charity patient who had never been well and was thin and pale had faint radiating scars around mouth, thick black painless scabs on the shins and a suggestion of Hutchinson's teeth. The physician had failed to recognize the condition, but now prescribed a specific in tonic form, which quickly brought recovery.

A girl, at the beginning of puberty, was obese, with coarse, greasy skin and pimples. She was extremely awkward and mentally was degenerating to subnormality. The mouth was uncared for and there was gingivitis. The teeth were all sound, but the cusps were short and poorly developed and there were spaced screw-driver upper central incisors.

Since the physician in the last case was an irresponsible talebearer, nothing could be said. But, in the end, on whom will the responsibility rest in case this patient does not get the proper attention? Occasionally, something of this nature develops to harry the dentist, who knows things which, while he should know them, are, in the minds of the greater percentage of those with whom he comes in contact, none of his concern.

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THE CENTENARY CELEBRATION

THE Centenary Celebration just held in Baltimore, March 18, 19, 20, signalizing the one-hundredth anniversary of the founding of dentistry, now passes into history as one of the most significant and unique meetings ever held in dentistry.

From the initiatory exercises of the American College of Dentists, held on Sunday, March 17, a foretaste of the inspirational nature of the meeting was sensed by all who took part in that introductory meeting, as it were.

The spirit of reverence, respect and appreciation for our historical heritage at once became the keynote, as well as theme, of the occasion, and the intensity and sincerity of this spirit increased until the happy climax was reached at the general session of Wednesday morning with the bestowal of honors by the University of Maryland on several of our leaders as an expression of appreciation of the accomplishments of dentistry as a public health service.

The first general session, Monday morning, March 18, at which several speakers of national prominence spoke, sounded the keynote of the

meeting, and those who were present on that occasion received an inspirational uplift that, in our individual case, was deeply impressive.

The addresses of the various speakers, the Honorable Herbert R. O'Conor, governor of the State of Maryland; the Honorable Howard W. Jackson, mayor of the City of Baltimore; Dr. H. C. Byrd, president of the University of Maryland, and Dr. William Mather Lewis, president of Lafayette College, indicated, in gracious manner, appreciation of the status which dentistry has attained in the estimation of those high in the political and the educational councils of the country. The particularly appropriate and brilliant address by Dr. Lewis, prophetically analytic and professionally inspirational, made an impress for good upon all present who had experienced in the recent past any anxiety as to the future welfare of dentistry.

In a profession sorely tried by the stress of depression and in a world harassed by the sordid expressions of greed on the part of nations as well as individuals, Dr. Lewis' remarks were as a beacon light in a hazardous sea, pointing the course to those who must carry the responsibility for the future of our profession.

At the second general session, the professional aspects and associations of dentistry were fittingly memoralized by our own President, Dr. Arthur H. Merritt, and by representatives of the other health professions: Dr. Nathan B. Van Etten, president of the American Medical Association; Dr. Andrew G. DuMez, president of the American Pharmaceutical Association; Dr. Edwin S. Godfrey, president of the American Public Health Association, and Dr. Thomas Parran, Surgeon General, United States Public Health Service. Dr. Parran's address was particularly noteworthy in that it distinctly marked the part which dentistry is destined to play in the department of governmental health service, which promises much to dentistry as a conspicuous participant in the application of health principles in their broadest implications.

The third general session indicated the estimation and appreciation in which the profession is held by the educational leaders of this and other countries. Dr. J. Ben Robinson, dean of the School of Dentistry of the University of Maryland; Dr. Jose R. Quiroga, official representative of the Bolivian Government; Dr. F. M. Dimas Aruti, official representative of the Santo Dominican Government; Dr. Raymond A. Kent, president of the University of Louisville, and Dr. H. C. Byrd, president of the University of Maryland, gave scholarly addresses. Dr. Kent's address was of particular interest and significance, in that the speaker

pointed the way to the practical integration of dental education with the university program.

Then followed a practical expression of the esteem and appreciation on the part of the University of Maryland for all that dentistry stands for, in the conferring of honorary degrees upon Dr. Harvey J. Burkhart, director of the Eastman Clinic of Rochester, N. Y.; Dr. Arthur H. Merritt, President of the American Dental Association, and Dr. William J. Gies, professor of biology at Columbia University. In thus honoring Drs. Burkhart, Merritt and Gies, the University of Maryland has signally honored dentistry, through recognition of the attainments of three distinguished men in the dental field: Dr. Burkhart as a lifelong counsellor, director and guide of the profession through the most critical stage of its development; Dr. Merritt as a distinguished periodontist and one who has brought cultural grace and dignity to the office of President of our national body, and Dr. Gies as the mentor of dentistry during a period of its development when its autonomy has been definitely determined.

This session was indeed a gala occasion for dentistry in indicating the cordial relations existing between dentistry and medical and educational interests.

The theme of this great meeting was the portrayal of the historical and developmental background of dentistry, and the historical exhibits indeed portrayed this phase of the dental profession in a most fitting and effective manner. Reproductions of dental offices of the various developmental periods were shown, together with a replica of the Baltimore College of Dental Surgery, the first dental school. In fact, the spirit of history so pervaded the atmosphere of the meeting that a number of the commercial exhibitors displayed and distributed numbers of old dental prints and pictorial portrayals of incidents of the early days of dental practice.

The scientific aspects of dentistry, while representing, as it were, the last word in dental development, presented most effectively the advances that have been made in adapting the facilities of dentistry to the great need of the people. Every phase of dentistry was represented by separate sectional meetings, all of which were exceptionally well attended and whose programs presented the latest advances in each particular phase of practice.

A feature of the meeting, and one that will live long in the memories of those who witnessed it, was the cavalcade of dentistry portrayed by

local talent on Monday and Tuesday evenings. The cavalcade was the enacted story of the developmental stages of the transition of dentistry from a more or less crude trade to the status of a full-blown profession. The audience was taken step by step from the days of the discovery of the need for a profession that could adequately care for mouth conditions that fell just outside the scope of medicine, to and beyond the founding of the dental school, the dental journal and the dental society. The characterizations were all excellent, and those of Hayden and Harris were particularly well done. The incidents and scenes surrounding the discovery of anesthesia by Wells were also realistically portrayed. In fact, the entire cavalcade was so impressively presented that all who witnessed it left the opera house with the feeling that they had almost seen and known those noble pioneers personally.

The recreational and entertainment features of the meeting were provided in characteristic southern manner. All those in attendance were most favorably impressed and delightfully entertained by this hospitality, which some one has designated as "almost aggressive," but "none-the-less agreeable" to all who are privileged to enjoy it.

To one who is at all familiar with the enormity of the task of preparing for such a meeting, it was evident that unusual perspicacity had been exercised in providing this delightfully unique occasion. Too much cannot be said in praise of the efforts of the Dental Centenary Committee for the completeness of the preparations. The unbounded thanks and appreciation of all who attended are extended to the committee, which did such efficient work under the capable and gracious leadership of the general chairman, Dr. Lucien Brun.

The Baltimore Dental Centenary Celebration will be recorded in dental history not as just another dental meeting, but as one of those notable occasions when men receive new inspiration and experience renewed energy and desire to share in the advancement of professional standards to still greater heights.

The dental profession of Baltimore has effectively shown not only that it is worthy of the title, the Cradle of Dentistry, but that it has been eminently capable of nurturing the infant through the many and hazardous vicissitudes of professional growth and development.

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Congenital Cleft Lip, Cleft Palate and Associated Nasal Deformities

By HAROLD STEARNS VAUGHAN, M.D., D.D.S., F.A.C.S. Professor of Clinical Surgery, New York Post-Graduate Medical School, Columbia University; Attending Surgeon, New York Post-Graduate Hospital, Etc. 210 pages; 259 illustrations. Cloth. Price $4.00. Lea and Febiger, Philadelphia, 1940.

This new book presents a brief review of the methods in vogue for the closure of congenital clefts of the lips and palate, with an extensive account of the methods found most suitable by the author. The book opens with short sections on the embryology and anatomy of the parts involved. These are followed by a description of the types of clefts encountered, and a short discussion of the operating room arrangements and instrumentation. The remainder of the book is devoted to a discussion and a description of the surgical procedures developed to close the clefts described. The book closes with chapters on the orthodontic management of cleft-palate cases and the uses of prosthetic appliances to close certain residual clefts. The function of the palate and tongue in speech is clearly described. The portions of the text dealing with the author's technics are adequately described. The book is profusely illustrated, mainly with line drawings, certain of which could be improved with a resulting increase in the clarity of presentation. The volume serves to present, collectively, suitable methods of treating congenital clefts and it will therefore be of interest and value to general and plastic surgeons.

Billy Forget-Me-Not

By MAUDE M. TANNER. Follett Publishing Co., Chicago, Ill. Price $1.00.

A delightful, cleverly illustrated story for the preschool and primary grade child is "Billy Forget-Me-Not." Billy, in the shape of a dwarf, visits Buddy in his dreams. Billy turns out to be a first permanent molar, which Buddy, despite the dwarf's warnings, sadly neglects. Happily, the dentist comes to the rescue in the nick of time, and Buddy promises to be more considerate in the future. From the standpoint of the child, the story is interesting. From the standpoint of the dental health worker, it lays too much stress on brushing and not enough on other preventive measures.

Root Canal Therapy

By LOUIS I. GROSSMAN, D.D.S. 237 pages; 90 illustrations. Cloth. Price $4.00. Lea and Febiger, Philadelphia, 1940.

It is evident, from the frequency of articles in the current medical and dental literature, that pulpless teeth are not being regarded as a severe menace to general health, as they were at one time. Reliable professional opinion now states that, although the relationship of root-filled teeth to various systemic diseases has had ample time for a thorough clinical evaluation, the exact association between the two is as faint or indefinite as ever before. It is now evident that the indiscriminate removal of teeth is not likely to influence the natural history of certain of the degenerative diseases, and that the patient will be best treated by conserving as many of his teeth as is practicable. To this end, this new book is a distinct contribution.

The volume begins with a short historical account of the development of root-canal therapy, followed by chapters on pulpless teeth and focal infection, pulp capping, pulpectomy, the diagnosis of pulp disease and a thorough account of root-canal filling as practiced by the author. Bleaching of discolored teeth and root amputation also come in for adequate discussion. The volume closes with a well-written chapter on the root-canal treatment of deciduous teeth, contributed by Elsie Gerlach.

Throughout the book, an admirable attempt is made to present the work in a logical, practical fashion. The description of the technic of filling root canals, electrosterilization and the bacterial culture of root canals is particularly good. All phases of this subject are adequately covered. The book should prove useful both as a text for students and as a reference work for practitioners.

COUNCIL ON DENTAL THERAPEUTICS

THE XTTRIUM TREATMENT FOR PYORRHEA—NOT ACCEPTABLE FOR A.D.R.

Report of the Council on Dental Therapeutics of the American Dental Association, authorized for publication.

THE Council's report on the Xttrium Treatment for Pyorrhea and the Xttrium Preparations was presented to the Xttrium Company in order that the firm might have an opportunity to provide scientific evidence in support of its claims. The Council referee and Council consultants have examined the firm's polemical reply and have concluded that it does not contain the scientific evidence required to warrant withholding the report or changing its fundamental character. In this, the Council concurs. In accordance with well-established policies and in conformity with its rules, the Council stands ready to reconsider the Xttrium preparations should direct and convincing evidence on their behalf be presented. The firm has informed the Council that scientific evidence regarding the products is being obtained. Meanwhile, the promotion of the preparations is apparently being extended and additional claims are being made. It should be noted that a statement of qualitative composition should now appear on the package labels of the products sold in interstate commerce. This is required by Federal law. The Council's report, prepared in response to numerous requests for information from members of the profession, follows:

One of the most recent of the many proprietary "pyorrhea" preparations offered the dental profession is called the Xttrium Treatment for Pyorrhea. The Council has received sufficient requests for information on the Xttrium Treatment for Pyorrhea to warrant this report.

According to the advertising literature, the Xttrium Treatment is built around these four products:

Xttrium-A: An antiseptic for irrigating pathologic pockets.

Xttrium-B: A preparation used to massage the gums and also to be forced into pockets.

Xttrium-C: A bone powder or similar material to be packed into pockets.

Xttrium-D: A combination germicide and mouth wash.

With the trade package are mechanical contrivances for the use of the various Xttrium products, advice concerning the application of these products and lengthy remarks regarding the etiology of "pyorrhea," influence of diet in the disease, etc. The technic recommended by the firm may be summarized as follows:

1. Thoroughly irrigate the pockets with Xttrium-A.
2. Check up on diet and elimination of the patient; recommend vitamin C, vitamin D and minerals.
3. Remove all calculus by thorough scaling.
4. Apply Xttrium-B with the applicator provided and massage the gums.
5. Recommend Xttrium-D and a soft toothbrush for daily massage of the gums.
6. After the scaling has been completed, apply Xttrium-C.

Obviously, the treatment is one that consists of removal of calculus, improvement of the diet, massage of the gums

and the use of the Xttrium preparations.

Many cases of pyorrhea have been successfully treated by the same or similar procedures without the aid of the Xttrium preparations. Therefore, it is important to examine the Xttrium preparations in the light of available evidence to determine whether there is any good basis for their use. It is apparent that the establishment of the usefulness of the Xttrium products must rest upon a sound basis of clinical and experimental facts. Owing to the nature of the disease or diseases for which they are recommended, it should be shown that the use of the various Xttrium products represents an advantage over the treatment of "pyorrhea" without drugs and the treatment of "pyorrhea" supplemented by the use of official or non-official accepted preparations.

The various Xttrium products are essentially of secret composition. A letter of inquiry directed to the Xttrium Company, Chicago, Ill., elicited a delayed response to the effect that the firm could not divulge the complete nature of its products because of the financial stake involved. The firm's reply contained no mention of financial considerations of more direct concern to the dental profession and to the public.

Apparently, one Laurenz Harris is the responsible officer of the Xttrium Company. A search of the available records indicates that Laurenz Harris is neither dentist nor physician. Possibly, he is a chemist, but he is apparently a member of neither the American Chemical Society nor the American Society of Biochemists. A search of the author indices of Chemical Abstracts and of the Quarterly Cumulative Index Medicus did not reveal mention of his name.

The Xttrium Treatment for Pyorrhea has been promoted to the dental profession by means of lectures, demonstrations, letters, advertisements in dental journals of a commercial nature and advertising pamphlets. Since promotional literature of this type is susceptible of ready appraisal, it will serve as a partial basis for the consideration of the Xttrium Treatment for Pyorrhea.

It would appear that a part of this treatment for pyorrhea is based upon the notion that, in essential respects, the teeth and the long bones are of the same nature. While the author or authors of the pamphlet leave a loophole of escape in the form of an obscure notation (a footnote concerning the enamel), he or they apparently intend to convey the definite impression that the teeth, like the bones, are subject to withdrawal of calcium. As a matter of fact, these statements are found in the advertising pamphlet:

> And both bone and teeth are living plastic tissues with their own metabolic processes, and are not dead, inert structures, as they were once considered. The calcium deposited in bones and teeth does not remain there indefinitely but it may be and frequently is redissolved and used to bring about a correct acid-base balance of the blood, when the diet contains too small an amount to maintain the correct balance.

A survey of the scientific literature indicates definitely that such notions concerning fully formed teeth are erroneous. According to Schour,[1] enamel and dentin are not subject to calcium withdrawal. This view is based upon extensive experimental and clinical findings by the following authors, among many others: Hunter,[2] Thoma,[3] Albright, Aub and Bauer[4] and Schour *et al.*[5]

It is interesting to note that, in the experiments conducted by Schour *et al.*, the combined factors of repeated pregnancy, lactation and a dietary deficient in calcium and vitamin D imposed upon parathyroidectomized rats did not result in the slightest withdrawal of calcium from the teeth. Each condition alone, however, has been found sufficient to produce withdrawal of calcium from the bones.

It would therefore appear that the similarity between "a lesion on a tooth"

and a fracture of "say, a long bone" are extremely remote, to say the least. Moreover, it is not clear what a lesion on a tooth has to do with "pyorrhea."

A part of the Xttrium Treatment for Pyorrhea consists in the local application of a preparation called Xttrium-C. According to the advertising pamphlet, "Xttrium-C is a heterogeneous bone complex from natural sources containing all the mineral constituents of bone in their natural proportions, in physiological sodium chloride solution, with ethyl alcohol and lubricant. Sterilized—255° F., 20 min., 20 lbs."

A careful study of the scientific literature, including those publications cited by the Xttrium Company on behalf of its own claims, indicates that there is no published clinical evidence of the usefulness of products such as Xttrium-C in the treatment of pyorrhea. Further than that, it should be emphasized that the local use of various bone preparations and calcium salts has not been found generally acceptable to surgeons, but that, on the contrary, such procedures are still apparently in the experimental stage and are actually in disfavor with some clinicians and investigators.

The information contained in references cited by the Xttrium Company appears to be in conflict with the claims made or implied in the promotion of Xttrium-C. Following is the reply to a query in the section entitled "Queries and Minor Notes," in the *Journal of the American Medical Association,* August 21, 1937, concerning the treatment of a case in which there was difficulty in obtaining union of a fracture:

> No medication of any kind has been demonstrated to have any effect in promoting bone formation, provided the blood calcium and phosphorus are within normal limits. Pulverized bone and venous blood have been injected at the sight of fracture without noteworthy results.
>
> The best form of stimulation is the promotion of function in the fractured bone.

In the advertising pamphlet, frequent reference is made to the work of C. R. Murray. In a 1934 publication, this author stated[6]:

> It must be remembered that the local source of calcium is only one in a complicated interrelationship of factors, and that, while there is evidence to show that it can be substituted for, the clinical application can be considered to be purely in an experimental stage and impractical for use at the present time.

On the other hand, Key[7] is even doubtful of results of an "experimental" nature. This author writes:

> Neither calcium phosphate and carbonate in the proportions in which they occur in bone, nor bone powder, made by the removal of the organic material from bone appears to stimulate osteogenesis of bone when implanted in a bone defect.

Bisgard,[8] whose excellent experimental studies are mentioned in the advertising pamphlet of the Xttrium Company, performed certain experiments on laboratory animals. These experiments showed that bone, regardless of viability, has a favorable influence on ossification. Whether the results obtained in the formation of osseous tissue in the eyes of rabbits (experimental animals used by Bisgard) can be applied in clinical medicine, let alone in dentistry, could be determined only by adequate clinical investigation. As a matter of fact, Bisgard, in discussing the clinical application of calcium salts and bone preparations, stated:

> Murray, who has stimulated a renewed interest in this subject, has presented much evidence, though inconclusive, that the repair of bone defects in animals and the repair of fractures in man are favorably influenced by saturating the site with the synthetic salts of bone, calcium carbonate, $CaCO_3$, and calcium phosphate, $Ca_3(PO_4)_2$.

On the basis of the available evidence in the scientific literature, it may be concluded that (a) the use of powdered bone of calcium salts or mixtures of salts in the treatment of fractures of long bones is in

the experimental stage, and (b) evidence concerning the usefulness of such preparations under experimental conditions is conflicting and inconclusive.

Even if it had been established that products of the Xttrium-C type or similar preparations are useful in treating fracture of long bones, the usefulness of these preparations in dentistry, and particularly under the recommended conditions, could be established only by clear-cut clinical evidence. As far as the Council is aware, there is no such evidence.

A search of the dental literature indicates that bone preparations for use in the treatment of pyorrhea have received little attention except perhaps from the commercial point of view.

In an interesting experimental study, Beube and Silvers[9] described the results obtained by the use of powdered beef bone in a series of cases. Of the cases studied, only five conformed to the dental diagnosis of periodontoclasia. Of these, one case was described as having been successfully treated. Of the various "pockets" in this patient's mouth, only one, a pocket 8 mm. deep, was subjected to the treatment with powdered bone. All the others responded to conservative treatment of the usual type. In the 8 mm. pocket, radical surgery was employed, "sterilized bone powder" was inserted and a flap retained with interrupted sutures. In discussing the case, the authors wrote:

> The regeneration of bone in this case of periodontoclasia may not be entirely due to the use of the bone powder, but may have been augmented by the reaction of the surrounding tissue to the operation, which was more extensive in this case than the four cases, thus creating a large amount of tissue death.

Apparently, the usefulness of powdered, sterilized beef bone in the treatment of periodontoclasia has *not* been established.

It should be noted that the healing of fractures in long bones has not been shown to be comparable to deposition of bone lost around a tooth affected with "pyorrhea." Alveolar bone could be rebuilt in height only if new periodontal membrane fibers could become attached to the tooth root above the base of the pocket, provided other factors were also favorable. However, no one has yet demonstrated satisfactorily that reattachment of periodontal membrane to teeth can be obtained clinically through the use of specific medicinals or combinations of drugs. So far as the Council is aware, there is no good basis for the discussion of Xttrium products in this connection, nor is it clear just how bone powder packed into a pocket can aid in building alveolar bone.

It may be surmised from the advertising literature that Xttrium-A, Xttrium-B and Xttrium-D contain chloramine-T and soap. The report of the Bureau of Chemistry indicates the same. The properties of chloramine-T and of soap, both of which are U.S.P. products, are well known. Indeed, a combination of chloramine-T and soap in the form of Chlorazene Surgical Paste-N.N.R. has been available for years.

Apparently, the combination of chloramine-T and soap, used in the Xttrium products, is covered by U. S. patents Nos. 1,950,956 and 1,950,957. These patents were granted to one Warner F. Wilhelm, and assigned to Marshall Field and Company, Chicago, Ill. According to the patent specifications, in patent No. 1,950,956, granulated chloramine-T may be sprayed with a solution of sodium stearate in chloroform. Apparently, the chloroform evaporates and a coating of sodium stearate is left on the granules. This is stated to prevent premature action of chloramine, among other things. U. S. patent No. 1,950,957 contains essentially descriptions of the use of products manufactured according to U. S. patent No. 1,950,956.

It should be noted that Xttrium-A, according to directions contained in the advertising pamphlet, is to be used in the

form of an aqueous solution. It is of interest to inquire concerning the fate of a "protective coating" under such conditions. Also, Xttrium-B, according to "directions," should be used in the form of a paste made up with *hot* water. There is no evidence, as far as the Council is aware, that such a paste differs materially from a paste made up with the single ingredients in Xttrium-B.

The discussion of surface tension, bacteria and bacterial toxins contained in the advertising pamphlet is apparently worthless for lack of suitable evidence. As far as the Council is aware, the rôle played by micro-organisms in the condition commonly called "pyorrhea" is unknown. The situation has been aptly summarized by Appleton[10] in these words:

> We must admit at the present time it is impossible to evaluate accurately the roles of the several microorganisms concerned.

Furthermore, a survey of the literature indicates that the rôle of surface tension in the action of various antiseptics, disinfectants and germicides, as these are employed clinically, has not been determined.

Frobisher[11] has concluded from a laboratory study that the addition of ethyl acetate or sodium oleate to hexylresorcinol increases the effectiveness of the latter compound against *B. typhosus*. The two former substances reduce surface tension. Such laboratory findings, inconclusive as they are, do not show that the addition of surface tension reducents is of clinical significance. Furthermore, this author observed that addition of an excess of sodium oleate to phenol or hexylresorcinol inhibits the bactericidal action of the latter substances. According to the data presented by this investigator, ethyl acetate may be preferred to soap as a surface tension reducent for antiseptics of the phenol type.

Of course, bacteria and other microorganisms may complicate the picture of "pyorrhea," for they are often associated with marked suppuration. But as this suppuration can be controlled by other means, Xttrium-A seems to offer no specific advantages over other well-known antiseptic substances. Certainly, it offers no apparent advantage over a mixture of chloramine-T, U.S.P. and soap, U.S.P.

Xttrium-D is a combination mouth wash and dentifrice. The following, which may be characterized as wishful thinking, is used in the promotion of this product:

> While it is true that bacteria can never be entirely eliminated from the human mouth, nevertheless, their number, particularly on the teeth and in the tissues about the teeth, can be kept so low that little or no harm will result from their presence. That such a condition is necessary to the successful treatment of pyorrhea is beyond question. The use of XTTRIUM-D by the patient, as directed, will keep bacteria at a minimum.

In view of the foregoing, and on the basis of the chemist's report, it can be seen that the Xttrium Treatment for Pyorrhea consists of semi-secret preparations made up from well-known ingredients, and disguised by uninformative names. Further, many of the claims made for these products are apparently not substantiated by acceptable evidence; on the contrary, much of the available evidence appears to be against these claims.

If the dentist desires to use chloramine-T and soap in the treatment of pyorrhea, it is unnecessary to obtain these products under fanciful names and at exorbitant prices. If the dentist feels the need of instruction concerning the treatment of "pyorrhea," he does not have to rely on the commercially biased information dispensed by the vendor of secret preparations. Unbiased and authoritative information can be obtained from a variety of textbooks and periodicals devoted to dentistry.

REPORT OF THE BUREAU OF CHEMISTRY ON XTTRIUM TREATMENT FOR PYORRHEA

One package of Xttrium Treatment for Pyorrhea was purchased on the open

market, price $27.65. The package label bore the following: "Xttrium Complete Outfit."

The contents of the package included a metal-jacketed syringe, four measuring glasses, several measuring spoons, several cannulae, a rubber device labeled "Xttrium Vacuum Cup Applicator" and several devices called "Xttrium Gum Massager and Stimulator." The large package also contained small blue glass jars labeled, respectively, Xttrium-A, Xttrium-B and Xttrium-D, and a carton containing four cartridges labeled Xttrium-C. At the bottom of each of the jars labeled Xttrium-A, Xttrium-B and Xttrium - D appeared the notation: "United States Letters Patent No. 1,950,956 and 1,950,957."

The large carton contained also six "case record" forms, duplicate folders of "Xttrium Treatment of Pyorrhea Price List," duplicate folders entitled "Xttrium Routine in the Use of Xttrium Treatment," duplicate booklets entitled "Xttrium Treatment of Pyorrhea," a mimeographed discourse entitled "The Dietary Factor in Pyorrhea with Special Reference to Vitamin C," a mimeographed brochure entitled "Résumé of Findings as to Germicidal Action on Oral Flora of Some Commonly Used Germicides" and a mimeographed letter addressed "Dear Doctor."

The package labeled Xttrium-A contained 25 gm. of white granular material with a faint chlorine-like odor. The package labeled Xttrium-B contained 16.25 gm. of white powder. The cartridges labeled Xttrium-C contained a gray, pasty material, the contents of each cartridge being approximately 1.25 gm. The three jars labeled Xttrium-D contained a white powder with a definitely rancid odor. The net contents averaged 16.6 gm.

Included with these various items was a bottle labeled "Xttrium Pocket Seal," which contained about 5 cc. of a highly odorous liquid that formed a tough film on drying, and a bottle labeled "Xttrium Pocket Seal Solvent."

Qualitative analysis of Xttrium-A indicated the presence of chloramine-T, soap, chloride and sodium.

Qualitative analysis of Xttrium-B indicated the presence of chloramine-T, soap, chloride and sodium.

Qualitative analysis of Xttrium-C indicated the presence of calcium, magnesium, phosphate, silica, chloride and carbonate.

Qualitative analysis of Xttrium-D indicated the presence of calcium, phosphate, sodium, chloride, higher fatty acid, glycerol, soap, chloramine-T and an oily substance which resembled palm oil.

Quantitative analysis of Xttrium-A yielded the following:

Per cent volatile at 105° C.	12.6
Per cent sulfated ash	27.9
Per cent active chlorine (Cl^+)	8.3
Per cent total chlorine ($Cl^- + Cl^+$)	9.9

Quantitative analysis of Xttrium-B yielded the following:

Per cent volatile at 105° C.	3.2
Per cent sulfated ash	24.4
Per cent active chlorine (Cl^+)	0.57
Per cent total chlorine ($Cl^- + Cl^+$)	0.78

Quantitative analysis of Xttrium-C yielded the following:

Per cent volatile at 105° C.	36.3
Per cent CaO	27.9
Per cent P_2O_5	21.1
Per cent chloride (Cl^-)	0.21
Per cent carbon dioxide	2.0

Quantitative analysis of Xttrium-D yielded the following:

Per cent volatile at 105° C.	11.8
Per cent CaO	18.3
Per cent P_2O_5	23.7
Per cent sodium (Na)	2.7
Per cent active chlorine (Cl^+)	0.078
Per cent total chlorine ($Cl^- + Cl^+$)	0.91
Per cent extracted by chloroform	32.4
Titratable acidity of dried chloroform extract	27.9 ml. NaOH (O.1N.) per gm. extract

(End of Chemist's report)

From the foregoing, it may be deduced that:

1. Xttrium-A consists essentially of chloramine-T (65 parts), soap (32.5 parts) and sodium chloride (2.5 parts).

2. Xttrium-B consists essentially of soap (95 parts) and chloramine-T (5 parts).

3. Xttrium-C consists essentially of phosphates and carbonates of calcium and magnesium, made into a paste with a saline solution and a lubricant.

4. Xttrium-D consists essentially of dicalcium phosphate (44.4%), chloramine-T (0.6%), moisture (11.8%), sodium chloride (1.4%) and a residue consisting of approximately equal parts of soap and fatty substances (fat and higher fatty acids). The fatty substance resembles palm oil in certain respects.

With respect to Xttrium-C, it should be noted that the ratio of calcium to phosphorus as determined by analysis is 2.15. The ratio calculated from a typical analysis for bone ash is 2.17.

The Xttrium Treatment for Pyorrhea consists essentially of well-known substances compounded and sold under uninformative and misleading names. These products are promoted with highly exaggerated and misleading claims, and at an exorbitant price. The Xttrium Treatment for Pyorrhea, including the various products which comprise it, is declared not acceptable for A.D.R. because of conflict with rules 1, 2, 6, 8 and 10.

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A copy of the rules that govern the Council in the consideration of articles will be sent on request.

Harold L. Hansen, *Secretary*.

PRESCRIBING SUGGESTIONS

THE rational use of drugs and chemicals is an essential part of dental practice. Over a period of years, the Council has issued numerous reports designed to aid the dentist in the selection of drugs and chemicals of demonstrated usefulness. Many of these are National Formulary and U. S. Pharmacopeial substances and are listed and adequately described in Accepted Dental Remedies 1939. In order that the dental profession may use acceptable and official products to best advantage, the following formulas have been suggested.

The Council appreciates the cooperation of George C. Schicks, assistant dean of Rutgers University, chairman of the Committee on Dental Pharmacy of the American Pharmaceutical Association, in the preparation of the formulas.

SERIES III

a)

℞	Metric Approx.	Apoth. Equivalents
Paraldehydi U.S.P.	1.0 cc.	m xv

*Ft. caps. dura †d.t.d. No. X

Sig: Two with a glass of water ½ hour before retiring.

Note: One of the safest of hynotics—rapid acting.
Disadvantage—taste not pleasant. Capsule disguises it.
Does not relieve pain.
Maximum dose—single 75 minims—daily 150 minims.
Average dose—30 ms. or 2 cc.
Sedative 15-30 ms. Sleep 30-60 ms.

*Caps. dura=hard gelatin capsules.

†Dentur tales doses (d.t.d.)=give such doses.

b)

℞	Metric Approx.	Apoth. Equivalents
Carbromali U.S.P.	0.5 gm.	gr. viii

Ft. caps. *dentur tales doses No. X

Sig: One with a glass of water for sleep at bedtime.

Note: Average dose 8 grains.
Maximum dose 15 grains.
Efficient, prompt sedative, producing sleep where a powerful hypnotic is not desired.
Useful in mental excitement, restlessness, anxiety.

*Dentur tales doses (d.t.d.)=give such doses.

SERIES III

c)

℞	Metric Approx.	Apoth. Equivalents
Tab. Barbitali	0.3 gm.	gr. v

*Dentur tales doses No. X

Sig: One with a glass of hot milk half hour before sleep.

Note: Hypnotic where prolonged action is desired.
Average dose 0.3 gm.=5 grains.
Maximum dose 1 gm.=15 grains. Larger doses usually not advisable.
Sedative 0.1 to 0.12 gm. (1½ to 2 grains) each dose.
Preoperative and postoperative medication.

May be prescribed as Elixir Barbital N.F. dose ℥ i (4 cc.) 2 grains of barbital in each dose.
Proprietary name—Veronal
*Means give of such doses.

d)

℞	Metric Approx.	Apoth. Equivalents
Tab. Phenobarbitali	0.03 gm.	gr. ss

*Dentur tales doses No. VI
Sig: Take one tablet the night previous to appointment and repeat one-half hour before office visit.
Note: Hypnotic and analgesic.
Average dose 0.03 gm.=½ grain.
Maximum dose 0.60 gm.=10 grains.
Sedative 0.015 to 0.2 gm. (¼ to 3 gr.)
Preoperative and postoperative medication.
May be prescribed as Elixir Phenobarbital N.F.
dose ℥ i (4 cc.). ½ grain phenobarbital in each dose.
Proprietary name—Luminal.
May be administered at office. Wait one-half hour before giving treatment.
*Means give of such doses.
ss (semissis)=one-half.

e)

℞	Metric Approx.	Apoth. Equivalents
Eugenol	1.2 cc.	m. xviiss
Peruvian Balsam	6.0 gm.	℥ iss
Acetylsalicylic Acid (fine)	15.0 gm.	ʒ ss
White Wax	6.0 gm.	℥ iss
Wool Fat q.s. ad.	60.0 gm.	ʒ ii

Dentists use for painful tooth sockets (dry sockets).
Note: Dental Anodyne Paste
Eugenol and Acetylsalicylic Acid are antiseptics and anodynes.
Consistency may be controlled by the quantity of white wax used.
May be obtained by prescribing Pasta Acidi Acetylsalicylici Composita N.F. VI.

f)

℞	Metric Approx.	Apoth. Equivalents
Guaiacol	3.0 gm.	gr. xlvi
Benzocaine	3.0 gm.	gr. xlvi
Balsam Peru	9.0 gm.	℥ii gr. xix

Dentists use for relief of pain in dry sockets.
Note: Antiseptic, anesthetic, promotes healing.

g)

℞	Metric Approx.	Apoth. Equivalents
*Aethyl Aminobenzoate	6.0 gm.	℥ iss
Alcohol	44.5 cc.	ʒ iss
Oil Cinnamon	0.13 cc.	m. ii
Liquor Amaranth	0.13 cc.	m. ii
Dist. Water q.s. ad.	60.0 cc.	ʒ ii

M.
Sig: Topical Anesthetic
Note: Apply to mucous membrane and wait two minutes before inserting needle.
Aethyl Aminobenzoate 10% in 70% alcohol.
*Common name Benzocaine; proprietary name Anesthesin

President's Message

DENTISTRY'S SOCIAL RESPONSIBILITIES: HOW ARE THEY TO BE MET?

THE thought probably uppermost in the mind of the dental profession at present is: How can the incidence of dental diseases be curtailed and the service which it alone is able to give be more widely distributed?

This is not a new thought. The profession has for years carried on (largely at its own expense) a program of research with a view to reducing the need for dental treatment through prevention, which is the only logical approach to the problem.

At the same time, it has conducted a country-wide program of education in the belief that *ignorance* as well as *indigence* is responsible for many of the dental ills complained of by those who undertake to speak for the 75 per cent who are said to be in need of dental care. This would seem to be confirmed by the published statement that 35 per cent of the public with incomes of $1,000 a year or less "own and drive an automobile." There can be little doubt in the minds of those familiar with the situation that it is ignorance of the importance of dental care, quite as much as inability to pay, that explains the present widespread neglect. It has been shown that when such treatment could be had, almost for the asking, those for whom the service was intended did not avail themselves of it.

While continuing to give of its service to those unable to pay for it, the dental profession is of the opinion that one of its first duties is to educate people to the importance of dental care (especially preventive care), in the belief that those able to provide for their own needs (which, doubtless, represent a considerable number) should be encouraged to do so. Some form of insurance or prepayment plan should be worked out to meet the needs of those in this group who may require such assistance. This should not be a difficult problem.

Further, the profession, as represented by the American Dental Association, is on record as being prepared to cooperate in any governmental plan to provide dental care for the indigent, asking only that it be consulted in the formulation of such plans and that they be fair to all concerned. Its opposition to the Wagner Health Bill (as originally drawn) was due solely to the fact that it complies with neither of these conditions.

The care of the medical and dental indigent is largely a responsibility of the state. It is no more the duty of the medical and dental professions to provide medicodental care for the indigent than to provide such care for any other group of citizens. If they are to be cared for in these respects, it should be at the expense of all the people, not of a small fraction of them. Likewise, it is not the responsibility of either the state or the professions to provide free medical or dental care for those of our citizens who can, and should, provide for their own needs. To do so tends to rob them of their self-reliance (if not their self-respect) and encourages dependence on outside agencies. It is too often true that "the highest price you can pay for a thing is to ask for it." It is this aspect of the problem that is opposed by the health service professions, not proper care of the indigent, which is clearly a responsibility of the state, and one in which the dental profession (and I believe the medical profession also) is prepared to cooperate to the fullest extent.

Is it unreasonable to believe that, with a return to normal economic conditions (which we have a right to expect), plus the efforts being put forth by the dental profession in the fields of education, research and prevention, the problem is one that will, to a considerable extent, solve itself, except for the wholly indigent? These, as has been said, are the responsibility of the state. And if to their care was added cooperation in education and research, the dental health problem would largely solve itself.

The responsibility of the dental profession, therefore, would seem to be:

First, to seek, by every means at its disposal, to limit the incidence of dental disease by research.

Second, to continue in its efforts to educate the public to the importance of oral health and the ways and means by which it can be obtained.

Third, to cooperate with the government or any other responsible agency in any reasonable effort that is made to provide dental care for the indigent.

Fourth, to oppose to the full extent of its resources every project to provide dental care for the public that is not in the interest of all the people.

Arthur A. Merrill

ASSOCIATION ACTIVITIES

MIDYEAR REPORT OF THE RESEARCH COMMISSION OF THE AMERICAN DENTAL ASSOCIATION

BOOK ON DENTAL CARIES

At the Milwaukee meeting of the American Dental Association, the Research Commission returned $678.47 of its budget for the year ending June 30, 1939. This money was returned because it was not used during the year for the publication of the book "Dental Caries." We presented the manuscript of the book "Dental Caries" to the Board of Trustees and asked it to accept the manuscript and to authorize publication. We stated that the proposed publication would cost around $1,500 for 2,000 copies. The Board accepted the manuscript and authorized publication. The book has been printed and distributed, and has received enthusiastic acclaim from all sources. Nearly 500 complimentary copies were distributed throughout the world to the medical and dental journals for review purposes, to leading dental authorities interested in caries research, to all officials of the American Dental Association and to all the contributors. To date, 461 copies have been sold.

The effect of the book on the dental world is expected to be far reaching, and it is not unreasonable to assume that its publication may be the keystone of all dental caries research, which will eventually solve the problem of the etiology of dental caries. The Association is greatly indebted to Dr. Gies for his work in compiling and editing the book.

The Research Commission is considering publishing a second edition of "Dental Caries" when the first edition is exhausted. Plans for the second edition are being outlined now and will be presented in detail to the Board of Trustees at the Cleveland meeting.

The entire distribution of the book has been handled from the secretary's office in Washington because the Business Manager of the Association felt that the Central Office could not handle it. The secretary of the Research Commission feels that the distribution of the book, although now handled as economically as possible under the conditions, could be more economically handled by the Central Office in Chicago and recommends that this be done in the future.

FELLOWSHIP AT THE NATIONAL BUREAU OF STANDARDS: REPORT FROM JULY 1, 1939 TO FEBRUARY 1, 1940.

TESTING OF CERTIFIED MATERIAL

After a manufacturer certifies to the Research Commission that his products comply with the specification of the American Dental Association, a sample of the material is procured on the open market by the Research Commission and is tested by the A.D.A. Research Associates at the National Bureau of Standards for

compliance with the specification. The results of this testing during the last seven months are herewith tabulated.

In accordance with the Commission's policy, any material failing to comply with the specification is not permitted on the Lists of Certified Materials.

Hydrocolloidal Impression Materials.—The final report is now in the hands of the Editor of THE JOURNAL.

Denture Base Materials.—Investigation of the acrylic resins is being continued with emphasis on measuring dimensional changes in dentures in service and in dentures submitted to a cycle of wetting and drying. Water absorption tests continue.

TESTING OF CERTIFIED MATERIAL

Material	Number Tested	Number Complying with Specification	Number Failing to Comply with Specification
Amalgam	5	2	3
Investment (inlay)			
Wax (inlay)	7	6	1
Impression compound			
Casting gold alloys (inlay)	8	5	3
Mercury	3	3	
Wrought wire	1		1
Zinc phosphate cement			
Silicate cement	1		1
Total	25	16	9

Base Metal Alloys.—Chemical analysis, indentation hardness and response to heat treatment tests are in progress. Properties of the accessory materials and the casting shrinkage of the alloys are being determined.

Cement.—Important physical properties of various types of cement, that is zinc oxide eugenol, zinc phosphate, silicate, red copper, black copper, silicophosphate and hydrocal, have been determined in preparation for a report at the Dental Centenary Celebration.

The report of the cooperating committee's work on silicate cement is completed.

A cement containing an abnormally high arsenic content was furnished the University of Illinois College of Dentistry for experimental purposes.

Standard samples of cement containing known amounts of arsenic were prepared for use in exchanging data with other testing laboratories.

Specifications.—The American Dental Association, at its 1939 annual meeting, approved Specification No. 10 for Denture Rubber, Specification No. 11 for Hydrocolloidal Impression Material and the revision of Specification No. 3 for Dental Impression Compound.

Specification No. 4 for Inlay Casting Wax has been revised.

A specification is being prepared for acrylic resin for denture base.

Miscellany.—The Editor of THE JOURNAL and authors of papers and books were given editorial assistance.

The properties of a "high tin" amalgam that is to be used in clinics were measured. This is an attempt to correlate clinical and laboratory data on amalgam.

Seventy-two visitors called at the laboratory to discuss various phases of the program.

Reports of the work were presented to the Golden Gate Dental Congress, Denver District Dental Society, Lincoln District Dental Society, University of Nebraska dental students, Richmond Dental Society, Ohio State Dental Society and the Dental Alumni Club of Baltimore.

A list of the publications of the reports of the work during the last seven months follows:

1. Lists of Certified Dental Materials: Research Commission. J.A.D.A., 26:1197, July 1939.

2. Annual Report: American Dental Association Research Fellowship at the National Bureau of Standards. J.A.D.A., 26:1728, October 1939.

3. Sweeney, W. T.: Denture Base Material: Acrylic Resins. J.A.D.A., 26:1863, November 1939.

BUDGET

The minimum budget on which the Research Commission felt it could function in 1939-1940 was $17,000. When this amount was cut 5 per cent, a situation arose that necessarily forces the Commission to run in the red during the year. A consideration of the facts involved will readily convince any one that this is necessary, unless the 5 per cent is restored or funds from outside sources are secured to carry on the work of the Commission. We feel that any outside funds that are secured by the Commission should be used for additional research activities and not for the regular support of the Commission's activities, which has now become a fixed expense. For example, we employ at the National Bureau of Standards in Washington four scientists whose salaries are modest for the type of work done. Nevertheless, these salaries absorb the bulk of the appropriation to the Bureau Fellowship. Little money is left over for the buying of materials and supplies for testing and experimental purposes. The amount of money allocated to the Research Fellowship at the Bureau last year was $14,500. This is a small amount for the kind of work that is being done. This amount has become practically a fixed charge and cannot be reduced without working a hardship on the men employed or interfering materially with the work being carried on at the Bureau. The amount appropriated is barely sufficient to carry on the work on a high plane. In fact, the appropriation to the Bureau should be in the neighborhood of $15,000 annually in order to allow us to expand naturally and to show the National Bureau of Standards that we appreciate its services in directing and continuing the work.

It must be remembered that the number of our specifications has increased to twelve and that many new materials have come on the dental market. The old materials must be continually tested in order to keep the lists up to date and, at the same time, we must be prepared to investigate the newer materials, such as the non-precious metals and the acrylic resins. In addition to these facts, it must be pointed out that, during the past several years, our taxes have increased so that almost $1,000 of the appropriation is used for such taxes as Workmen's Compensation, Social Security and unemployment. This was pointed out in our report at Milwaukee last year, and a reading of that statement will give the exact figures for the previous year. These taxes increase our budget, and allowance for this increase must be made in future allocations.

All in all, the work of the Commission since the Milwaukee meeting has been progressing very favorably. In view of the facts stated above, it is requested that the 5 per cent reduction made at Milwaukee be eliminated and that our original minimum budget of $17,000 be definitely allocated for the year ending June 30, 1940.

ORGANIZATION

In order to avoid the Research Commission's becoming a one-man organization, it is necessary that the executive board meet at least once between national meetings to transact such business as may rightly come before it at that time. In between such meetings, the board members can be kept adequately informed about events by correspondence. Such correspondence means additional work in the secretary's office, but this is the best procedure under our present set-up.

PROPOSED FELLOWSHIP AT NATIONAL INSTITUTE OF HEALTH

Definite progress toward the establishment of a fellowship in dental diseases at the National Institute of Health in Washington has been made during the past half year. The secretary of the Commission has held several personal conferences with the Surgeon General of the United States Public Health Service, and we believe that the fellowship will be established at the Institute once the initial $5,000 is appropriated for such purposes. We strongly advise the Board of Trustees to consider the appropriation of $5,000 for this purpose at the Cleveland meeting in September.

The above-mentioned fellowship in dental diseases should not be confused with the work which the National Health Program Committee of the American Dental Association is doing in securing from the United States Congress a sum of money for the United States Public Health Service to be earmarked for dental research. The work which this important committee is doing, under the able leadership of the chairman, Harold W. Oppice, is receiving the active support and cooperation of the Research Commission. If Congress appropriates this money for dental research, it will of course go directly to the United States Public Health Service, and the American Dental Association will have no direct control over its expenditure. It is hoped that the American Dental Association will have indirect control in an advisory capacity. If we had, at the National Institute of Health, an established fellowship in dental diseases, such a fellowship would enable us to keep in intimate contact with any dental research which the United States Public Health Service might be undertaking now or in the future. Therefore, we believe that the need for the establishment of the fellowship in dental diseases at the National Institute of Health is all the more urgent now that the National Health Program Committee has instigated plans for securing from Congress a definite amount of money for dental research.

During the past year, the Research Commission has been offered funds for research purposes from several organizations. Following are the names of the organizations making such offers and the amount of the offer: American Full Denture Society, $250; International College of Dentists, $500. It is the desire of the Executive Board of the Research Commission that the Board of Trustees accept these amounts for the Research Commission and that this money be used for dental research as agreed upon between the donor and the Executive Board of the Research Commission.

We are informed that, in addition to the amount specified above, the American Full Denture Society is contemplating giving us $250 this year, and the National Society of Denture Prosthetists is also considering giving us $250. The money which these two societies have given to the Commission in the past has been used for research work in denture materials, and the money which they are now giving to us will also be used for such research.

PERCY C. LOWERY, *Chairman.*
DANIEL F. LYNCH, *Secretary.*
Washington, D. C.
February 6, 1940.

COMMITTEE ON LEGISLATION

EXPERT TESTIMONY vs. LAY TESTIMONY IN DENTAL NEGLIGENCE ACTIONS

By Leslie Childs, Indianapolis, Ind.

In actions for damages against dentists, based upon charges of negligence, the question of the character of the testimony essential to a recovery, whether expert or lay, may be of great importance. And here we find, as a general rule, that this will depend on the nature, scope and character of the acts claimed to have resulted in the injury.

Where such acts involve the science of diagnosis or methods of treatment, the merits of which could be passed upon only by medical men, expert testimony will usually be required to establish a charge of negligence. On the other hand, when the alleged acts do not involve questions of professional skill or knowledge, lay testimony may be ample to sustain a judgment rendered upon the facts. As illustrations of judicial reasoning in applying the "expert evidence" rule, the following cases are in point.

DENTIST BREAKS NEEDLE

In Capolupo *vs.* Wills, 116 Conn. 13, 163 Atl. 454, the plaintiff requested the defendant, a dentist, to extract a tooth. A hypodermic needle inserted to anesthetize the jaw broke. The defendant attempted to locate the broken point both by taking x-ray pictures and by probing, but was unsuccessful, and the after-treatment failed to give the plaintiff relief.

Thereafter, the plaintiff went to a hospital, where a surgical operation was performed for the purpose of locating and extracting the needle. This too was unsuccessful, and when the plaintiff brought the instant action against the defendant for damages, based upon allegations of negligence, the needle still remained in his jaw.

On trial, the plaintiff's medical evidence tended to indicate that he had a partial paralysis of the right side of the tongue. When water was held in his mouth, he drooled somewhat. In speaking, there was a pulling of the lips. The plaintiff's medical evidence described his condition as a "traumatic injury to the inferior dental nerve."

However, the plaintiff, it appears, failed to show by expert testimony that the defendant had been negligent either in extracting the tooth or in postoperative treatment. The trial court instructed the jury that there was no evidence of negligence in extracting the tooth.

The court, however, permitted the jury to pass upon the question of whether the defendant had been negligent in the postoperative treatment. The jury gave the plaintiff a verdict for $1,100 on this phase of the case. The defendant appealed from this judgment and the higher court, in reviewing the record and in holding there was error for want of expert evidence, in part, said:

> If we adopt the view of the trial court that the allegations of the complaint furnish a sufficient basis on which to rest a verdict upon this phase of the case [postoperative treatment], there still remains the question whether the evidence was such that the jury could reasonably have found that the defendant was negligent and thereby injured the inferior dental nerve by what was done following the breaking of the needle.

Reading the entire evidence, we are unable to find any evidence which can be fairly said to remove this question from the realm of speculation. There is no evidence that the attempt to take x-ray pictures and the probing and cutting were negligently done. The surgical operations at the hospital are at least possible sources of this nerve injury and there is nothing in the evidence to exclude this as the cause.

If there were such evidence, the fair conclusion would be that the injury was caused by the attempts of the defendant to remove the needle the night of the operation. Even so, it would not follow without expert medical evidence upon that point that such injury was caused by the negligence or unskilfulness of the defendant, and there is no evidence of this character in the present record.

We have heretofore had occasion to consider the necessity for expert medical evidence to establish negligence, whereas, in malpractice cases, professional conduct is involved. "When a topic requiring special experience of an expert forms a main issue in the case, the evidence on that issue must contain expert testimony or it will not suffice." . . .

We consider the record evidence insufficient to establish negligence in this respect and are unable to sustain the action of the trial court in refusing to set aside the verdict. There is error, and a new trial is ordered.

In Lindloff *vs.* Ross, 208 Wis. 482, 243 N.W. 403, the court reached a like conclusion. The facts were many and involved, but, as far as material to the question under discussion here, may be summarized as follows.

PATIENT SUFFERS BROKEN JAW

The plaintiff applied to the defendant, a dentist, for treatment. The defendant extracted a horizontally impacted third molar tooth. This was in August. September 9, the plaintiff returned and, after taking an x-ray picture, the defendant discovered and extracted another impacted third molar tooth. Some infection followed this, for which the defendant treated the plaintiff.

About this time, the plaintiff developed other physical disabilities, for which he was attended by physicians and surgeons. December 3, after the second dental operation, the plaintiff said that, while on an automobile trip, his jaw seemed to "pop" and blood flowed from his gum. Examination disclosed a broken jaw. The defendant treated this and wired the jaws, and, after about six weeks, when the wires were removed, the result was pronounced excellent by the physician who examined the plaintiff at that time.

Thereafter, the plaintiff brought the instant action against the defendant for damages on the theory that his jaw had been broken September 9, when the second impacted tooth had been extracted, and that the defendant had been negligent in not discovering the condition. On trial, the defendant offered expert testimony tending to show that the fracture was pathologic and that it had not occurred when the tooth was extracted.

The plaintiff offered no expert testimony that in any way indicated a lack of care or skill on the part of the defendant in treating him. On this state of the record, the trial court rendered judgment for the defendant. The plaintiff appealed, and the higher court, in reviewing the record and in affirming the judgment, reasoned, in part, as follows.

EXPERT TESTIMONY HELD ESSENTIAL

In order to hold a dentist liable, the burden rests upon a plaintiff to show that the dentist failed in the requisite degree of care and skill. . . . The degree of care and skill which must be exercised can only be proved by the testimony of experts. Without such testimony, the jury has no standard which enables it to determine whether the defendant failed to exercise the degree of care and skill required of him. . . .

The plaintiff claims that his jaw was broken on September 9 as a result of the operation; in other words, that it was a traumatic fracture. The defendant, on the

other hand, claims that the plaintiff's jaw was not broken at that time; that the fracture was not traumatic but pathologic, and that it resulted from the disease condition due to infection. The defendant and several experts testified that the fracture was pathologic.

No attempt was made by the plaintiff to deny or contradict such testimony. It appears that a fracture may result from disease without a blow, strain or force. All of the evidence is obviously as consistent with that of a pathologic fracture as that of a traumatic fracture. In this situation, the jury ought not to be permitted to speculate or conjecture as to the cause of plaintiff's fracture. . . . [We] think the trial court was right . . . in rendering judgment for the defendant. . . . Judgment affirmed.

So much for the foregoing, and now let us examine some of the authorities on the other side of the question; i.e., where lay testimony was held proper in proving negligence on the part of dentists. Here, Francis *vs.* Brooks, 24 Ohio App. 136, 156 N.E. 609, is in point. The circumstances that culminated in the action were, briefly stated, as follows:

FACTS IN THE CASE

The defendant, a dentist, undertook to extract an impacted, unerupted bicuspid tooth on the right side of the plaintiff's jaw. The record showed that this tooth was so large as to involve nearly the entire jaw bone. The defendant enlarged the socket by using a small drill. He then extracted the tooth, but, as he did so, the root tips broke off, and in the attempt to loosen up the tips, the jaw was broken.

In the suit for damages that followed, the plaintiff recovered a judgment, based, it appears, upon lay testimony. On appeal, the defendant stressed this point and contended that the judgment should not be allowed to stand in view of the absence of expert testimony in support of the plaintiff's case. In passing upon this, the court first observed:

It is quite conceivable that cases arise in which the existence of expert testimony is essential to enable a jury to determine whether a physician, surgeon or dentist has been guilty of malpractice, but it is not true that such testimony is necessary in all cases. If a violation of the defendant's duty to his patient appears from other competent evidence in the case, the plaintiff might certainly refrain with safety from calling expert witnesses.

After the foregoing, the court reviewed the record in detail in respect to how the defendant proceeded in extracting the tooth. Then, in passing upon this evidence, as to whether it would sustain the verdict, in the absence of expert testimony, the court, among other things, said:

It will be noticed from this testimony that [the defendant] removed a portion of the jaw bone surrounding the tooth to the extent of one or more strips three-sixteenths inch wide, and that this was continued to the bottom of the tooth socket, which practically extended to the lower margin of the jaw.

This unerupted tooth, situated in the lower jaw, appears to have grown downward instead of upward through the gum, so that, according to the testimony of [the defendant], the process of removing the bone surrounding the tooth was continued until he had proceeded nearly through the jaw bone.

With this testimony and that coming from other witnesses, we cannot say that the general verdict for the plaintiff is clearly and manifestly against the weight of the evidence, nor can we accede to the contention that such a verdict could not be rendered, unless supported by expert testimony. . . . Judgment affirmed.

Another case of this class was Ellering *vs.* Gross, 189 Minn. 68, 248 N.W. 330. Here, the defendant, a dentist, was fitting a bridge in the plaintiff's lower right jaw. While he was polishing the bridge with an electrically operated revolving disk, the latter slipped off the bridge and cut the base of the plaintiff's tongue. Suit for damages followed, based upon the claimed negligence of the defendant.

The latter countered with the statement that the accident resulted from the act of plaintiff in suddenly moving her head.

In proving her case, the plaintiff did not introduce any expert testimony, but appears to have relied upon her version of the circumstances. This was contradicted by the defendant, as far as it imputed negligence on his part. The jury, however, gave the plaintiff a verdict for $1,500. From judgment thereon, the defendant appealed and, among other things, contended that the award should not be upheld, because of the lack of expert evidence of negligence on his part. In passing upon this, the higher court in part reasoned:

> The cause of the movement of the dental instrument from the bridge to the tissues of the mouth was not a scientific question. . . . It is to be borne in mind that the injury was not produced by any intended treatment, so that proper practice is not directly involved. Nor is there any claim that the defendant did not use proper practice in the treatment of the wound inflicted. Recovery depended on proof that the wound in the plaintiff's mouth was caused by the carelessness or negligence of the defendant while using the instrument mentioned. . . .
>
> Cases are cited by the defendant involving the method and skill of a dentist in extracting teeth where unlooked for injuries resulted. Of course, as a rule, it is then necessary to a recovery to prove by experts that the method pursued by the dentist was not good practice. . . . But, as before stated, neither the instrument used nor the method of fitting the bridge is questioned, but the lack of ordinary care and skill in applying the instrument so that it entered and injured tissues not intended to be treated.

In conclusion, the court affirmed the judgment on the condition that the plaintiff consent to its reduction to $1,000; the case otherwise to go back for a new trial.

From the foregoing, it is clear that the nature of, and circumstances culminating in, a dental practice accident will be determinative of whether expert testimony will be required to prove negligence on the part of the dentist. If the accident is such as to raise a question of whether the dentist employed proper skill, methods or care, as viewed from a scientific standpoint, expert evidence will, as a general rule, be necessary.

On the other hand, if the accident results from acts of commission or omission on the part of the dentist that are susceptible to layman judgment, in respect to whether they constitute negligence, expert testimony may be dispensed with. And, under such circumstances, lay testimony may be sufficient to uphold the findings of a jury on questions of fact thereon.

1520 East Tenth Street.

PROSECUTION FOR SALE OF MAIL ORDER DENTURE

THE outcome of the most recent Illinois case on mail order dentures indicates the use of a new and effective procedure for the prosecution of persons engaged in the sale of dentures by mail. December 12, 1939, the federal grand jury in Chicago returned criminal indictments against John and Josephine Alger, charging them with violation of the postal laws in conducting the sale of mail order false teeth.

The evidence indicated that the Algers did a thriving business in the rural areas with the aid of a $1,000 a month advertising campaign, in which they promised:

> You can laugh with Alger teeth. You can eat corn on the cob. Alger teeth do not ache.

In 1936, the year after the Algers went into business, they had receipts of

$33,816.99, the grand jurors found. They also found that the witnesses were unable to speak clearly with the dentures purchased by mail and that the teeth did not fit and otherwise failed to give satisfaction. On this evidence, indictments were returned charging the Algers with using the mails to defraud. Conviction of this offense carries a maximum penalty of a $10,000 fine and ten years' imprisonment.

Subsequently (January 16, 1940), the defendants pleaded guilty to the charge of mail fraud and made application to the court for probation. The judge referred the matter to the United States probation officer for investigation and the judge will make his decision on the basis of the probation officer's report.

The action of the United States Supreme Court in October 1939 in refusing to review the decision of the United States Court of Appeals in the case of S. B. Heininger had the effect of upholding the validity of the fraud order which had been issued by the Post Office Department against Heininger. This order declared that the mail order denture business, as conducted by Heininger, was fraudulent and therefore a violation of the postal laws. The approval of the validity of this order finally disposed of the Heininger case by branding his mail order business as fraudulent and denying him the use of the mails.

The indictment of John and Josephine Alger was based upon the logical conclusion that if the activities of Heininger were fraudulent and a violation of the postal laws, the mail order business conducted by the Algers was in the same category. The rapid disposal of this case indicates the value of the Heininger decision in the settling of this question.

In addition to the prosecution of the Algers, the United States district attorney notified all persons engaged in "mail order dentistry" in the Chicago area that they must be out of business by December 31, 1939 or face prosecution by the government. The majority of the concerns have obeyed this notice. Those which have continued to do business in violation of the order will be prosecuted for using the mails in furtherance of a scheme to defraud.

NATIONAL BOARD OF DENTAL EXAMINERS

At the last session of the National Board of Dental Examiners, held December 4 and 5, the following candidates were successful in passing Part II: William Guth Schiff, John Meierkord, Davis Henderson, Allan Louis Springer, Donald H. Moon, Nathan Peck, George A. Zurkow, Donald Todd Waggener and Norman Oliver Harris.

Sessions were held in Boston, Chicago, New York, Philadelphia, Iowa City, St. Louis, Baltimore, Atlanta and Rochester, Minn.

There were eleven successful candidates who participated in Part I. The next session of the Board will be held May 6-7.

Morton J. Loeb, *Secretary*,
66 Trumbull St.,
New Haven, Conn.

THE NATIONAL HEALTH PROGRAM COMMITTEE

BILL TO PROVIDE $75,000 FOR DENTAL RESEARCH BY PUBLIC HEALTH SERVICE IS INTRODUCED INTO CONGRESS OF THE UNITED STATES

A BILL to provide $75,000 for dental research to be conducted by the United States Public Health Service into "the cause, diagnosis and treatment of dental diseases" was introduced into the Congress of the United States on March 18, by Senator James E. Murray, of Montana. The bill also provides for an annual increase of $10,000 in the appropriation for the next five years.

The bill was prepared through the agency of the National Health Program Committee and the Research Commission of the American Dental Association in order to make effective the first part of the program which was adopted by the House of Delegates at the Milwaukee meeting in 1939. This program provided for (1) intensified and coordinated dental research; (2) an enlarged and expanded program of dental education, and (3) dental care for the indigent when funds were made available for that purpose.

With the death of the Wagner Bill almost a certainty, it is doubtful whether the Federal Congress will enact any national health program legislation during the present session. The program of the House of Delegates, however, was not adopted to combat pending legislation, but rather as the most constructive approach to the problem of dental security. For this reason, the Association, through the National Health Program Committee, took the initiative to secure funds to expand and coordinate dental research.

The bill was introduced by Sen. James E. Murray, junior senator from the state of Montana. Senator Murray is chairman of the subcommittee of the Committee on Education and Labor of the United States Senate, which has been considering the Wagner Health Bill (S. 1620). Senator Murray has recognized the importance of dental research as the basis of dental participation in a national health program by introducing S. 3607.

The text of the bill follows:

S. 3607
A BILL

To authorize research by the Public Health Service relating to the cause, diagnosis and treatment of dental diseases.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Surgeon General of the Public Health Service is authorized and directed to conduct researches, investigations, experiments, and studies relating to the cause, diagnosis and treatment of dental diseases; to assist and foster similar research activities by other agencies, public and private, and to promote the coordination of all such researches and activities and the useful application of their results, with a view to the development and prompt widespread use of the most effective methods of prevention, diagnosis and treatment of such diseases.

Sec. 2. There is hereby appropriated, out of any money in the Treasury not otherwise appropriated, to carry out the provisions of this Act, the sum of $75,000 for the fiscal year ending June 30, 1941, and for the five succeeding fiscal years such sum shall be increased $10,000 each year.

AN EXECUTIVE SECRETARY FOR THE AMERICAN DENTAL ASSOCIATION

At the midwinter meeting of the Board of Trustees of the American Dental Association, held in Chicago, February 9, 10, and 12, 1940, Gerald D. Timmons, former acting dean of the Dental School of Indiana University, Indianapolis, was appointed Executive Secretary of the American Dental Association.

Dr. Timmons' duties, as outlined by the enabling resolution of the Trustees, adopted in St. Louis, 1939, will be to make a thorough study of the various activities of the Association, with particular reference to the possibility of better coordinating these activities to avoid overlapping of effort, to increase effectiveness and to bring about economies where possible; also to make an analysis of the activities of the Association now carried on outside the Central Office, allocating the duties to present personnel or recommending the establishment of such additional bureaus or commissions as may be advisable.

Dr. Timmons is widely known in Association circles as former acting dean of the Indianapolis school and as a Trustee of the A.D.A. from the Seventh District. For the past seven years, he has been secretary-treasurer of the American Association of Dental Schools.

March 1, Dr. Timmons actively assumed his duties as Executive Secretary.

PROPOSED ASSOCIATION OF DENTAL STUDENTS

At the meeting of the Trustees of the American Dental Association in Chicago in February, the President, Arthur H. Merritt, asked for action of the Board of Trustees on the proposed plan for organizing an association of dental students as a national organization maintained by and representing the student bodies of the various dental schools.

The matter was referred to a committee of the Trustees, which reported as follows:

Your Committee has considered the question of an association of dental students, as presented by Dr. Merritt. We look with disfavor upon another undergraduate dental organization that appears to be in direct competition with the Junior Membership Plan of the American Dental Association. We feel that if the dental students have time for and desire a more active organization, it can be effected within the present set-up of the Junior Membership.

The reason given for the organization of American dental students is more freedom of activity and an independent journal, which, it is stated, is not offered by the A.D.A. Junior Membership. It is assumed that this journal would be supported by advertising and therefore would be a further load on the dental trade and another competitor to existing journals.

We suggest that the same objectives could be accomplished if the school authorities would encourage the formation of active junior A.D.A. societies, permitting the students to select their own faculty advisers and conduct their own elections and activities. Their need for a literary outlet might be provided by allotting space to them in THE JOURNAL.

We, therefore, recommend that the Secretary communicate at once with the deans of all the dental schools, advising them

of the Board's disapproval of the formation of the "Association of Dental Students" and requesting their cooperation in effecting a more active organization of the schools' Junior A.D.A. Membership.

We further recommend that Gerald D. Timmons be delegated to appear before the American Association of Dental Schools at its approaching meeting and explain our position as outlined above.

The recommendations of the committee were unanimously adopted by the Board of Trustees.

AMERICAN RED CROSS

NOTICE—MEDICAL TECHNOLOGISTS*

At the request of the Surgeon General of the Army and in compliance with its policy of cooperation with both the Army and Navy, the American Red Cross, as an expansion of its peace-time service for the military forces, has undertaken the enrollment of various types of medical technologists who are willing to serve in the Medical Department of the Army or Navy if their services are required at the time of a national emergency.

Persons with the following qualifications will be enrolled:

Chemical laboratory technicians (male)
Dental hygienists (male and female)
Dental mechanics (male)
Dietitians (male and female)
Laboratory technicians (male and female)
Meat and dairy hygienists (inspectors) (male)
Nurses (male)†
Occupational therapy aides (male and female)
Orthopedic mechanics (male)
Pharmacy technicians (male and female)
Physical therapy technicians (aides) (male and female)
Statistical clerks (male and female)
X-ray technicians (male and female)

General qualifications for enrollment are as follows. Applicants shall be: 1. Citizens of the United States. 2. Aged 21-45 years (Army); 18-35 (Navy) (men only). 3. Physically qualified. Applicants must pass satisfactorily a physical examination, according to standards set respectively by the Army and Navy Medical Departments. 4. Unmarried (woman applicants). 5. Willing to serve as a technologist in a time of national emergency.

Male technologists will be eligible for enlistment in the Army as non-commissioned officers in the grades of sergeant, staff sergeant and technical sergeant. Woman technologists, and men who enroll but who may later be found physically unqualified for military duty, will be eligible for employment by the Army as civilians.

For the Navy, male technologists will be eligible for enlistment in the Naval Reserve as petty officers—pharmacist's mates 3d, 2nd and 1st class and chief pharmacist's mate (acting appointment). Woman technologists are not eligible for service in the Navy under present plans.

The Medical Department of the Army will require a considerable number of

*A statement prepared by the American Red Cross *re* the enrollment of dental hygienists and dental mechanics for possible service in the Army or Navy in the event of a national emergency. This action has the approval of the National Defense Committee of the American Dental Association.

†This group will not be members of the Army or Navy Nurse Corps, which, under basic law, is limited to women, but will be used as technologists for service auxiliary thereto.

technologists in each of the above-named groups. The Navy Medical Department requirements will be similar except for dietitians, occupational therapy aides, orthopedic mechanics and dairy and food hygienists (inspectors), who will not be needed. Notwithstanding the maintenance of this enrolment, the Navy also desires peace-time enlistment in the U. S. Naval Reserve, and male technologists who wish to enlist in the Naval Reserve are urged to communicate directly with the commandant of the Naval district in which they reside. The address of their commandant will be furnished upon request.

Technologists who qualify according to these general standards and who are willing to enroll for service as outlined above should communicate with the American National Red Cross, Washington, D. C.

EIGHTY-SECOND ANNUAL SESSION OF THE AMERICAN DENTAL ASSOCIATION, CLEVELAND, OHIO SEPTEMBER 9-13, 1940

HEADQUARTERS ASSIGNED TO AMERICAN DENTAL ASSOCIATION GROUPS

WHEN the American Dental Association holds its Eighty-Second Annual Session in Cleveland, September 9-13, there will be ample hotel facilities to accommodate the numerous associated groups that meet prior to and during the convention.

J. V. Gentilly, general chairman of the Local Arrangements Committee, and C. W. Marriott, chairman of the Associated Groups Committee, have issued the following assignments to the groups requesting hotel accommodations.

The Hotel Statler, the Association's Headquarters, has been reserved for the Officers, Members of the House of Delegates and executive committees. The House of Delegates will convene in this hotel.

The Public Auditorium, the largest in the country, and only seven minutes' walk from all leading hotels, will house all of the clinics, lecture sessions and scientific and commercial exhibits.

The Hotel Cleveland will be headquarters for the:

American Academy of Periodontology.

American Academy of Restorative Dentistry.

American Society for the Promotion of Dentistry for Children.

American Association of Public Health Dentists.

American Dental Assistants Association.

Alpha Omega Fraternity.

Psi Omega Fraternity.

The Hotel Carter will be headquarters for the:

American Society of Exodontists.

American Association of Dental Hygienists.

Delta Sigma Delta Fraternity.

The Hollenden Hotel will be headquarters for the Xi Psi Phi Fraternity.

It is estimated that more than 10,000 visitors will attend this convention.

BUREAU OF PUBLIC RELATIONS

PROCEEDINGS OF THE AMERICAN PUBLIC HEALTH ASSOCIATION*

THE importance of dental health programs as a part of the whole health scheme was proved by the number of dental papers presented at the various sessions of the American Public Health Association meeting in Pittsburgh. For the benefit of the readers of THE JOURNAL, the following summaries are presented. Future issues of the *American Journal of Public Health* will undoubtedly include most of the articles in their complete form:

THE PROBLEM OF DENTAL CARE IN THE PUBLIC HEALTH PROGRAM

By FRANK C. CADY, D.D.S., C.P.H.
Dental Consultant to the State Health Authorities, U. S. Public Health Service, Washington, D. C.

Only in recent years have health agencies given serious thought to the wide prevalence of accumulated dental defects. In fact, it was only a few years ago that any attempt was made on a nation-wide scale to determine the extent of these defects.

Dental caries is unique among the public health problems; first, because it is a chronic, unspectacular disease that does not kill directly and, second, because it affects the only tissue in the body which cannot repair itself. . . .

The primary objective of a dental program must be the servicing of the yearly increment of this disease. . . .

From a dental health educational standpoint, we classify the public in three main groups: first, those who can well afford dental service, but are not informed as to the advantage of early and periodical treatment; second, those who can barely afford treatment, but prefer to spend what is left of the pay check for luxuries, and, last, those on a subsistence level or below who, no matter how well educated, cannot pay for service. . . .

Many of our programs are educationally top-heavy. It appears that the time has come when all health workers must give more attention to the service side of the dental health program, even though the road be rocky and fraught with difficulties.

The resulting calculation suggests that such agencies place only about 3 per cent of the estimated fillings required. On the basis of service for indigent children, only 15 per cent of the need is provided, if we assume that 20 per cent of the total school population falls in that category. These figures are estimates, but are indicative of the manner in which all health agencies in ninety-four predominantly urban areas are meeting the problem of dental care for needy school children. . . .

If the health department is to fulfil its responsibilities to the indigent members of society and the non-indigent in sparsely settled communities, it must provide facilities for adequate medical and dental care for these groups as well as for preventive services.

*These extracts of the dental papers read at a meeting of the American Public Health Association, Pittsburgh, Pa., October 15-19, are presented through the courtesy of Dr. J. M. Wisan, Trenton, N. J.

EDUCATION TO IMPROVE DENTAL CONDITIONS

By J. M. Wisan, D.D.S.
Dental Health Consultant, New Jersey State Department of Health, Trenton, N. J.

If dental conditions are to improve, a dental health program of four phases should be carefully planned: (1) utilizing all the resources of health education to help individuals achieve dental health; (2) guiding administrators of dental programs toward making progress; (3) presenting authentic dental health information to all who are concerned with health instruction, and (4) informing dentists of advances in preventive dentistry and concerning public health needs.

HOW COMMUNITY DENTISTS CAN PARTICIPATE IN A SCHOOL DENTAL PROGRAM

By S. S. Lifson
Research Assistant, School Health Study, Astoria, N. Y.

The attack of dental disease has proceeded along several lines: (1) improvement in diet; (2) hygiene of the mouth; (3) dental examination; (4) a universal program of dental examinations and treatment, and (5) dental examinations and treatment for selected children.

The program for the school children in New York City consists of the following activities:

A. The teachers carry on an educational program and distribute leaflets. There are, however, no definite procedures to guide the teachers in their follow-up program.

B. School dental clinics are maintained for examination, prophylaxis and corrective treatment. Although there are 120 of these clinics, this service reaches but a small proportion of those who need it.

C. Other privately supported free clinics and also part pay clinics are maintained.

D. The school physician inspects the children's mouths.

E. The children go to private dentists of their own accord, or are referred as a result of school examination.

The Astoria plan has been evolved along the following lines: (1) that all children should be examined to discover dental defects, and all such examinations of the mouth should be made by dentists; (2) that the responsibility for guiding the dental health program should be in the hands of the classroom teachers.

Dental decay in school children is a recurrent problem. The school nurse and doctor are unable to get the necessary funds to provide for continuous detection and correction of dental defects. The school assumes the responsibility for teaching facts about dental health. What is more logical than that teachers assume a major responsibility in this specialized program, which is essentially educational in nature?

In setting up machinery for the execution of this plan, school administrators, principals, teachers and dentists confer with the district health officer. Letters signed by the school principals, designed to educate parents to realize the danger of neglect in dental decay and stressing the importance of seeing the dentist, were distributed by the teachers. On the reverse side of the letter, space was provided for the examining dentist to indicate what teeth were decayed and whether the child was under his care.

Ten days to two weeks later, a follow-up program was conducted. The teachers used three forms of letters. Letter A was for the child who had not yet gone to the dentist for an examination. Letter B was for the child who had been to the dentist for an examination, but had not yet sought treatment. Letter C urged the parents to see that treatment was continued and completed as soon as possible. Accurate accounts of the progress and status of each child were given.

As a result of the program, 6,436 children from kindergarten through the eighth grade were examined. Of the children who received the letter on dental care, 88 per cent responded by visiting a private or clinic dentist for examina-

tion. The dentists reported that 81 per cent of the children examined were in need of dental treatment. Of this group, 76 per cent obtained treatment. By the end of the school year, in more than half of the children that were being treated, treatment was completed. Of all the children contacted, 12 per cent had not been examined by a dentist. Of the total group of children, 17 per cent had not sought needed dental treatment.

SHORT COURSES IN DENTAL HEALTH FOR PUBLIC HEALTH NURSES

By VERN D. IRWIN, D.D.S.
Superintendent, Dental Health Education,
Minnesota Department of Health,
Minneapolis, Minn.

In short courses, public health nurses and other members of a public health personnel can become acquainted with the fundamental problems of dental health as it relates to the life, welfare and health of the people. Surely a public health worker should have a more fundamental knowledge of teeth than merely that of the unusual conditions. Why medical schools and nursing schools should give the teeth and mouth so little attention in the curricula, it is difficult to understand. It now seems that, with the new interest taken by all health departments in dental health and the demands made upon their personnel for dental health assistance and information, this deficiency will sooner or later be taken care of. . . .

Primarily, a short course in dental health should be designed to give the members of the class a fundamental knowledge of the growth, development, functions and anatomic design of the teeth and jaws, as well as an understanding of dental disease in its relation to the health problem. To better understand abnormal and disease conditions, it is imperative that the normal and the healthy be shown for comparison. Should there be enough time on the program to take up field problems of the public health nurse as her duties are related to the dental problem, a questionnaire should be first sent to the nurse to ascertain what those problems are. The questions may be listed for her to check and space may be left for others to be added, if these problems are sufficiently well known in advance. A period should then be provided to openly discuss the local problems. Further assistance might still be given by providing for a discussion of the integration and relationship of the dental program with other public health work and with community organization.

PUBLIC HEALTH ADMINISTRATION OF A DENTAL PROGRAM

By DON W. GUDAKUNST, M.D., Dr. P.H.
Senior Surgeon, U. S. Public Health Service,
Washington, D. C.

In planning the administration of a public health dental program, we must recognize several facts and then adjust our program to meet these facts.

1. The dental health of a vast majority of the people of this country is bad. Adequate statistics have been collected to show that dental disease is the most prevalent physical defect. These findings need not be reviewed here.

2. There is an inadequate number of dentists to furnish the care needed today.

3. There would be no reasonable means of financing complete dental care for all economic classes, even though there were enough dentists to render the service.

4. The problem is made still more difficult because of the fact that there is no proved "prevention" of dental disease. There is only alleviation. Prevention in dentistry exists only in circumvention of the development of additional disease. Death or loss of the tooth is prevented by repair of the disease condition. . . .

Public health programs are subdivided into two main categories, educational and service. We attempt to teach people to do things for themselves. That is education. Then, we give to them those things in the way of direct service which they could not otherwise secure. . . .

If we recognize the fact that nearly every person needs dental care, and that

there have accumulated dental defects to a number far beyond our ability to remedy, it would seem worse than pointless to engage in an ever-increasing dental education program aimed at sending all people to dentists for care for all their needs. . . .

Dental education in our schools and industries, and for our public at large, must, of course, go on. The plea is for reasonableness and purposefulness. No educational program should be instituted or continued until there is a definite provision for meeting the created demands for service. . . .

The clinic must adjust its procedures in accordance with fixed policies. It is for the health administrator, to the best of his limited ability, to say how much service shall be given and to whom. It would appear wise to conduct a public dental care program of sufficient scope to treat only the new defects in the group served. Only patients presenting new defects, new cavities, new dental disease conditions should be considered eligible for clinic care. The clinic must be prepared to ignore the overwhelming mass of accumulated defects, allowing them to go their way, to be eliminated only by time itself. This is a difficult method to follow. . . .

The public health administrator, in planning his dental program, cannot hope to radically alter the picture in any short period of time. The idea is advanced that the program might well embrace three phases: (1) education of the public as to the value of early and repeated visits to the dentist; (2) limited dental clinic care, and (3) redirection of at least some of the work of the private dentists.

AN ADMINISTRATOR COGITATES HIS DENTAL HEALTH PROGRAM

By Harold D. Chope, M.D.
Director of Public Health,
Newton, Mass.

Within the limits of administrative health units, the problem of the local health officer in organizing a dental health program is, first, Is a dental health program necessary in my community? There probably is no community in the nation that can answer this question in the negative. It is true that this problem varies in degree. . . .

What is the health officer going to do about it? The health officer falls back on the fundamentals which he has learned in the school of public health:

1. The detection and correction of defects has been shown inadequate in the field of oral hygiene.

2. Unfortunately, no procedure has yet been developed that will immunize against dental caries.

3. There is no evidence that hygienic measures will prevent dental disease.

4. The epidemiologic approach has been of no avail.

5. The health education program involves its own problems: a. The organization and direction of such a program. b. The responsibility of obtaining funds. c. The selection of suitable personnel. . . .

The recent organization of the oral health group and the number in attendance here today seem to indicate that the dental profession has chosen the wise plan of conferring with health officers in the solution of dental programs. Health administrators, school teachers, dentists, dental hygienists, nutritionists and public health nurses all play an important part in the dental health program. Once the health officer has assembled his oral health staff, he finds himself confronted with the following questions:

1. Is the health department going to operate a clinic?

2. Where shall the clinic be located?

3. What type of equipment shall be purchased?

4. What social group is eligible for care in the clinic?

5. What age groups should be included?

6. Who is to determine eligibility?

7. Who is to be responsible for the detection of defects?

8. Shall the hygienist offer prophylactic service to all school children? . . .

We must admit that there is no known procedure that will prevent dental caries and disease of the supporting structures. The best we can hope for is to teach children the fundamental principles of mouth hygiene and to detect, as early as possible, the defects that are found to occur even under the most favorable conditions in our present state of civilization so that the useful surface of the tooth may be rebuilt before irreparable damage has been done. Our program has been in full effect only two years, and yet we have been able to honestly demonstrate a decrease in serious oral disease. Our survey of 1937 showed 73.9 per cent of the children to be in need of dental care. This year's examination for the same schools shows 43 per cent in need of oral care—a step in the right direction, but a long way from our goal. . . .

My comments that reflect disappointment in the lack of leadership in dental health among average private dentists are not directed to the members of this group, but rather to the well-trained man who is so intrigued with his ability to pull, plug and replace—his mechanical skill—that he fails to give thought to the broader social and health implications of his chosen profession; disappointment in the men who will spend four days listening to papers on clinical dentistry and debating the horrors of socialized dentistry, but will not even travel across the state of Missouri to consult with their colleagues in the public health field who so need their help. To you pioneers, blest with the vision to organize the oral hygiene group, we health officers express our gratitude, for your interest and guidance in helping to solve our common problems of oral health.

THE PUBLIC DENTAL HEALTH PROGRAM

By Richard C. Leonard, D.D.S., F.A.P.H.A.
Chief, Division of Oral Hygiene, Maryland State Department of Health, Baltimore, Md.

Conservative estimates indicate that no less than 80 per cent of the whole population need, or will shortly need (for restored dental health is not assured of everlasting self-maintenance), dental treatment of a corrective or a restorative nature. Being even more conservative, one can assuredly state that 75 per cent, or more than 97,000,000 of the population, are now, or shortly will be, in need of dental care. The crux of the problem that this need presents rests in the matter of how this necessary treatment is now being or may in the future be accorded. This raises several points in our problem; namely, the present available facilities and suggested means of enlarging existent facilities for treatment. . . .

With a total of 97,000,000 potential clients to be divided among the 70,000 dentists (for the moment, hypothecating that such an equal distribution might be possible), there would be a clientele for each dentist numbering approximately 1,400. The next queries are: How nearly are the total number of dentists rendering competent and complete dental service to the estimated total of potential dental patients and how nearly can they render complete and competent service? The answers to both queries rest on calculations as to the average amount of time needed for complete dental care by each of any given group of people or the average amount of time needed for the group as a whole.

An estimate of this needed amount of time was derived recently from a study made in St. Louis, and the figures are, I believe, as accurate as is possible from such a difficult calculation. The estimate was: seventeen hours per person a year as the average time necessary for complete dental service of both corrective and restorative nature. . . . The

seventeen hour average requirement would mean, for the hypothetical 1,400 patients of each dentist in the United States, a total requirement of 23,800 hours a year, and there are but 8,760 hours in a year, and, like other folk, dentists cannot work twenty-four hours a day. Hence, it is obvious that the dental profession of today neither is rendering nor can render all the dental service needed. . . .

In other words, the available hours offered to the public by the dental profession for dental care are not being utilized to the fullest extent because of lack of appreciation by the public of the true value of dental health and of functional normality of the mouth tissues. It is estimated that not more than 20 per cent of our population avail themselves of existing dental treatment facilities. That is, only 280 of the 1,400 potential patients of each dentist are seeking dental service of any scope, complete, adequate, minimum or emergency. All of the 280 are not getting, they are not asking for, complete dental service. . . .

Before going on to a discussion of these essential subclassifications in dental care, let me reiterate that it is due largely to ignorance that more people are not demanding and receiving complete dental service. Consequently, a first step toward solving the problem of public dental health might well be lay education in the importance of mouth health and its relationship to general or systemic health. . . .

Dental service may be divided into several categories, all based on deviation from the ideal—complete service. Complete service is constituted of treatment that removes all conditions of disease from mouth tissues and, at the same time, restores to them what approaches 100 per cent functional efficiency. . . .

Adequate dental care has been defined as dental treatment in which all pain, discomfort and infection are eliminated and in which there is a restoration of the greater part (at least 65 per cent) of normal function. Recently, this type of service has been suggested as a possible panacea for the entire dental problem. Were such treatment possible (i.e., from the standpoint of time consumption), it would, obviously, be less desirable than "complete" treatment. . . .

Below "adequate" dental treatment may be listed "minimum" dental care, which implies relief of pain and discomfort and the elimination of all oral foci of infection. Minimum service discounts all or nearly all question of function. . . .

Finally, there is emergency treatment which is self-defined, being merely the elimination of pain and discomfort and possibly the elimination of some infection as a byproduct of pain relief. . . .

Happily, this second suggestion—concentration on preventive dental service for children—has a natural, close relationship to the first mentioned, "lay education." It is among children that the educational project promises the happiest results. . . .

If the definite causes of dental ailments, some of which are still unknown, could be found, certainly preventive measures to offset these causes would be developed. . . .

The fallacy of compulsory dental health insurance is even more apparent from a casual glance at the primary principles of insurance. All insurance—life, fire, theft, accident, etc.—is based upon the premise that a minority of policy holders will at any one time become the beneficiaries of their policies. The premiums paid by a majority provide the benefits received by a minority; but, under a compulsory dental health insurance program, a majority would at once be potential beneficiaries. So if it were physically possible for all to receive dental care, even over a considerable period of time the cost would be prohibitive. . . .

A second suggestion recently made as a solution of the problem proposes the augmenting of the dental profession by short-term training personnel, trained, supposedly, to render certain phases of dental care now available only from the dental profession. Such proposals, logical as they may first appear, are vicious and ill-advised. . . .

Children's dentistry, of all phases of dental practice, needs for its success a background of thorough training and comprehension of the causes and effect of both dental ailments and their corrections. The premise of the proposed children's dentistry technician plan is correctly based on the belief that the dental health problem as a whole must be divided and attacked on the basis of varying age groups. . . .

1. There is a comparatively small group of the population whose financial status prohibits dental care. Government subsidies should be granted to cover the expense of rendering adequate dental care to this group.

2. A large part of the population could, if it would, "afford" dental treatment. It is an interesting commentary on the relative appreciation accorded certain aspects of modern life that twice as much money is spent annually for cosmetics and four times as much for tobacco as is spent for dental service. Such attitudes are not, of course, to be changed overnight. The process of educating to a true appreciation of health will take time. Meanwhile, dental leaders are attempting to meet the situation by developing systems of voluntary dental health insurance by and for individual families.

These plans, still in the making, offer dental care on a budgeted basis that places competent dental service within the reach of all except the indigent group. Thus, dentistry is trying to add an administrative aspect to its already herculean effort to solve the problem of dental ill-health.

REDUCTION OF DENTAL CARIES BY DIETARY SUPPLEMENT

By Mark D. Elliott, D.D.S.
Forsyth Dental Infirmary, and
Dorothea Nicoll, Nutritionist,
Massachusetts Department of Public Health,
Boston, Mass.

. . . The following report contains the results of a dental nutrition study conducted upon sixty-two children at the state tuberculosis sanitorium (bone and joint tuberculosis) located at Lakeville, Mass. . . .

A group of sixty-two children between the ages of 5 and 15 years, of both sexes, were studied. These children were divided into two groups. No differentiation into comparable age groups was attempted. The diets of each section were identical with one exception. One, which we shall call Group A, received in addition to the regular diet 8 ounces of tomato juice daily. Four ounces was given in the morning and four in the afternoon. The other, Group B, received only the regular sanatorium diet, with no supplement. At the end of fifteen months, the groups were reversed; i.e., Group A, which had been receiving the tomato juice, now became the controls. The administration of tomato juice to them was stopped and it was given to the other children in Group B. The study was continued for nine more months and the results were noted. Nothing was taken away from the diets of either of these groups nor was the carbohydrate intake reduced. The children of both sections, wearing only trunks, were being exposed daily to either direct sunlight or carbon arc radiation. The skin of all the children was richly tanned.

METHOD OF MAKING DENTAL EXAMINATION

With the assistance of the dentist at the Lakeville State Sanatorium, Emanuel Kline, each child was given a thorough dental examination at the beginning of the study, in January 1932, and subsequently at four-month intervals. The

examinations were made by the same dentist each time, one who had had considerable experience in examining the teeth of children. The cavities were charted upon record cards containing diagrams of the deciduous and permanent teeth and the charting was done with a different colored ink each time. . . .

It was found possible to reduce the incidence of dental caries 71 to 75 per cent in groups of children in a state tuberculosis institution by supplementing the usual diet with 8 ounces of canned tomato juice daily, in order to increase the supply of Vitamin C.

SHALL WE SELL DENTISTRY SHORT?

By Leon R. Kramer
Director of the Division of Dental Hygiene,
Kansas State Board of Health,
Topeka, Kan.

. . . As president of the American Association of Public Health Dentists, I believe it to be my duty to urge those in state departments of public health to make it possible for the dental personnel to operate as a separate division rather than as a subdivision. Special training of all directors of dental programs will eventually make it possible to elevate our educational standards. Health officers, health nurses, public health dentists, teachers, nutritionists, hygienists and others can contribute to the dental health program. Within the department of health, dental directors should utilize the public health laboratory, division of vital statistics, educational department, division of sanitation, division of local health, division of communicable diseases, bureau of venereal diseases, division of epidemiology and division of child hygiene, all of which may be of service to a dental director. . . .

The educational program conducted with schools should be supplemented with visual education programs. The lending library of dental films will be found invaluable. Postgraduate courses in preventive dentistry should be offered to dentists. . . .

Three years ago, when the dental division was established in the Kansas State Board of Health, fewer than 40,000 dental cases were reported in the State of Kansas and only a few dollars were spent by school boards for inspections and corrections. During the last year, 220,000 dental inspections were made and clinical services were made available to the indigent children in approximately 50 per cent of the localities in which the program operated. . . .

An attempt has been made only to point out the magnitude of our field of activity, and to show dentistry's unlimited possibilities in public health. I have endeavored to show the necessity of visualizing the entire field in public health and to map a plan of attack. The necessity of invoicing our resources in counsel and in personnel has been stressed. Emphasis has been laid on the importance of setting up a dental organization in the health department—a division that will warrant the respect, attention and support of the dental profession. I have stated that special training assists the director of dental programs to synchronize the activities of the dental division with those of all the other divisions of a department of health. You have been given outlines of activities carried out with the division of child hygiene and of the school program and a few of the highlights of both programs. We have shown our relation with other divisions in a health department, and our field of service to state institutions and national projects.

We have made a hurried flight over the entire field of public health. In view of this vast panorama of possibilities, which can be developed by the dental hygiene division in conjunction with the profession of dentistry, in the promotion of education in dental care, dental corrections and fundamental research, are we going to build a program in which

our profession can find unlimited expression? Or shall we, as public health workers, ignore the 64,000 members of the dental profession, ignore the public we serve and sell dentistry short in the field of public health?

DENTISTRY IN PUBLIC HEALTH PLANNING

By Harry Strusser, D.D.S., F.A.P.H.A.
Chief, Division of Dental Service,
Department of Health,
New York, N. Y.

. . . The control and prevention of dental disease must be given prominence because of the large percentage of the child and adult population suffering from dental disease or its concomitants. . . .

A study by the dental division of the department of health, several years ago, of dental conditions in the preschool group showed that, at the age of 2 years, 48 per cent of the children examined had dental caries; at the age of 3, 85 per cent; at the age of 4, 93 per cent, and at the age of 5, 93 per cent. . . .

We have found, in two studies of 1,000 and 1,250 persons, that about 45 per cent needed two dentures and 22 per cent needed one denture. In other words, 67 per cent needed dentures for masticating efficiency. . . .

We have a definite objective toward which we are always striving. At the present time, however, with our limited facilities, we must devise ways and means of providing the community with service for the largest number at the least expense to the taxpayer, making sure that that service is of the highest type within the ability of dentistry. . . .

In the programs of the schools where we have dental hygienists and dentists, classes that have attained 100 per cent correction are given banners. On presentation of these banners, the class that receives the award usually prepares a dental health educational program. Here, we have another opportunity for both school and health authorities to bring home the lessons of dental and general health. It is here that parents receive information as to how to cooperate with us and instructions as to how their children can carry out the lessons taught. . . .

1. Each community can set up a program in accordance with its own particular circumstances, conditions and ability to continue such effort. There are many types of programs that can be fitted into the general scheme.

2. It is not wise to begin on a large scale and then, because of financial difficulties, discontinue the program entirely. It is advisable to set up a program and to learn from experience the road to follow.

3. Dental expenditures, when all of the children's dental needs are taken into consideration and a program for their care has been provided, will diminish and continue to diminish.

4. If we follow a program of education and prevention with the child, we will eventually overcome the condition now existing in the adult population as pointed out in my paper and which has been the outstanding drawback in the formation of plans for dental care of the American people. It is too expensive, and when we begin to consider the available budgets for all public health work, we must decide what is more essential.

FRONTIERS IN DENTAL HEALTH EDUCATION

By Florence B. Hopkins, M.D., D.M.D.
Dental Pediatrician, Division of Child Hygiene, Massachusetts Department of Public Health, and
Jean V. Latimer, A.M., F.A.P.H.A.
Coordinator of Health Education, Division of Child Hygiene, Massachusetts Department of Public Health, Boston, Mass.

Probably no phase of public health has increased more in scope and changed more in method during the last few years than that of health education. . . .

Dentistry as a profession has not lagged behind in its interest in the prevention of disease and the promotion of health education. . . .

Dental health is an educational as well as a medical problem. Not only must the individual know the scientific facts associated with the care and preservation of the teeth; he must also be motivated to choose and to act on such practices as will promote the best possible dental health. . . .

The dentist must learn more of pediatrics, child growth and development and child psychology. An effective community dental health program must be a cooperative project. . . .

The activity program in health education in which the dental health areas are selected in the terms of the needs, interests and abilities of children is making it possible to think of dental health as a part of the general health education curriculum. . . .

FACTS ABOUT ORTHODONTICS FOR HEALTH WORKERS

THE Public Relations Bureau of the American Association of Orthodontists has recently prepared a small but informative 6-leaf pamphlet on orthodontics which will prove helpful to the dentist and other health workers. The text is printed below. Additional copies can be secured direct from the American Association of Orthodontists, Room 22, 2 East 103d St., New York, N. Y.

FACTS ABOUT ORTHODONTICS FOR HEALTH WORKERS

Q. *What is orthodontics?*

A. A division of the practice of dentistry having to do with the prevention and correction of irregularities of the teeth and deformities of the face and jaws.

Q. *Can these irregularities and deformities be prevented or corrected?*

A. Yes, in most cases.

Q. *How do such irregularities come about?*

A. Tendencies to malformation are hereditary or acquired. The acquired type may be glandular or dietary, respiratory or environmental. There may be interference with normal growth of the bones of the head and face. Diseased tonsils and adenoids often promote mouth breathing; removal of deciduous teeth too soon, or retention in position too long, also may contribute.

Q. *Are there any other contributing causes?*

A. Sucking habits and improper posture during waking or sleeping hours exert pressures interfering with normal growth.

Q. *Explain the effect of proper breathing through the nose as it relates to growth of the bones of the face and jaw.*

A. With the mouth closed, as in normal breathing, muscular pressure of lips and cheeks is able to balance that of the tongue. Air traversing nasal passages creates a stimulus in the direction of normal growth. With the mouth open, these indispensable factors to normal growth fail to function.

Q. *How does the premature loss or prolonged retention of deciduous or baby teeth affect growth?*

A. Lost too soon, adjoining teeth may shift, thus reducing the space intended for the permanent teeth. Lost too late, succeeding permanent teeth may be prevented from arranging themselves properly.

Q. *If baby teeth are lost too soon, what should be done?*

A. The space of the missing tooth should be watched, and if it tends to

close, a space retaining device should be attached to an adjoining tooth to keep it open.

Q. *If baby teeth are retained too long, what should be done?*

A. They should be x-rayed to determine the condition of the roots, whether the permanent teeth are coming in or not, and if present, the deciduous baby teeth should be removed. In all cases consult your dentist; he will know whether you should consult an orthodontist.

Q. *What may result from interference with proper tooth arrangement?*

A. Malocclusion—failure of the teeth to mesh properly both in repose and when chewing, producing an improper "bite," and affecting the appearance of the face.

Q. *Can malocclusion be harmful to health?*

A. Yes. When teeth are not in proper relationship to each other, they do not grind and prepare food as they should before it is swallowed. This may interfere with proper digestion and throw a load on the stomach and intestines. In time, these organs revolt and fail to function because of carrying a burden they were never intended to bear.

Q. *Is malocclusion a causative factor in the decay of teeth?*

A. Teeth which are not in their correct position suffer the effects of disuse or wear and tear of over-use. This prepares the way for decay and encourages the development of diseases of the gums.

Q. *Do irregular contacts between teeth have any bad effect?*

A. Decay usually results. If teeth are bunched together or overlap, cleanliness is difficult to maintain. Infection from decay is known to spread to many parts of the body, producing serious secondary diseases. Another avenue of disease invasion is swallowing contaminated saliva when gum infection is present.

Q. *Is personal appearance affected by malocclusion?*

A. Teeth may become too conspicuous, or jaws protrude or recede too much. If such defects become too noticeable, the result may be to produce a definite feeling of inferiority which is disturbing to personal security. The child's true personality may be distorted and the effectiveness of his adult life impaired.

Q. *At what age should orthodontic treatment be instituted?*

A. There is no fixed age in all cases. The nature and extent of the imperfection determines the time. If the child shows irregularity at any age, a consultation should be arranged. Parents should place a child under observation both for general dental care and for early detection of possible irregularities after the eruption of the baby teeth and regularly thereafter as growth continues.

Q. *Is orthodontic treatment ever indicated between the ages of 3 and 6 years?*

A. Yes. When the child's mouth shows plain evidence of interference with normal growth.

Q. *How does the orthodontist go about his work?*

A. First he makes a thorough examination of the patient as an individual and studies his history and background. He may make a plaster cast of the teeth, gums and jaws and take face measurements, and x-ray films to assist him in determining the exact nature of the abnormality.

Q. *How is treatment undertaken?*

A. No two cases are quite alike. Treatment is adapted specifically to each case, in the effort to stimulate growth in the right direction and discourage it in the wrong direction.

Q. *How is this growth stimulated?*

A. It is brought about by controlling the forces at work, which may include the solution of problems of breathing, diet, muscular habits. Systemic disorders may be suspected, which should be referred to a physician for examination. Delicate appliances which the orthodontist fits to the teeth are adjusted to the

special problem. Over the course of time the results obtained are observed, and treatment is varied to conform to changes as they are brought about.

Q. *Is it actually possible to change the formation of the bony structure of the jaws?*

A. Yes, in most instances. In a few cases the maximum results cannot be realized, but most cases, taken in time, with treatment regularly continued for a sufficient period, result in marked improvement—safeguarding the health and correcting noticeable malformation.

Q. *Is this all there is to "straightening crooked teeth"?*

A. *Orthodontics concerns itself with growth. Teeth are not just forced or pried into or out of position by the exertion of mechanical pressure. If this were true one could easily make an apparatus at home and apply it to the teeth to push them in the desired direction. On the contrary, orthodontics is a highly specialized division of dentistry which requires specific knowledge of fundamental sciences, which alone makes it possible to apply corrective treatment.*

MARCH 11 CENTENNIAL CELEBRATION

THE March 11 nationwide centennial celebration commemorating the one hundredth anniversary of dentistry was 100 per cent successful, every state, the District of Columbia and Canada participating, with dinners or similar programs in 325 of the 419 district and component societies of the American Dental Association.

Arthur H. Merritt's excellent radio address given over the N.B.C. Blue Network Monday evening March 11 served as a thread which bound the widely scattered meetings into a unified whole.

The Columbia Broadcast on Tuesday evening, "Americans at Work—The Dentist" also served to focus public attention on dentistry and its contribution to the health, happiness and appearance of our citizens.

The Centennial Committee takes this opportunity of thanking the officers of every state and component society for their cooperation in making this celebration successful. The component celebrations, held as they were a week prior to the Baltimore meeting March 18-20, served as an excellent prelude to that memorable event.

LON W. MORREY, *Secretary,*
HAROLD S. SMITH,
OTTO W. BRANDHORST, *Chairman.*

1840 DENTAL PLEDGE 1940

As a suitable climax to the March 11 centennial programs, a framed copy of the dental pledge, signed by Arthur H. Merritt, was presented to each guest of honor by the president of each component dental society. A copy of the pledge is reproduced on the following page. The pledge itself is 11 by 14 inches and is printed in three colors.

Realizing that many dentists will want one of these pledges for their offices, the committee had a few extra copies printed. They sell for 80 cents unmounted.

Should you desire one for your office or home, order from the Bureau of Public Relations, American Dental Association, 212 E. Superior St., Chicago, Ill.

1840 **DENTISTRY** 1940

A century measured by endless time is unimportant. A century measured by human history is not long. But a century measured in terms of scientific progress, alleviation of suffering and improvement of human welfare is deeply significant.

Dentistry recognizes the past century's scientific discoveries which have enabled it to improve its services to mankind. It is proud of its progress and aware of its failures.

The past century won for dentistry a professional heritage; endowed it with a scientific discipline; developed its technical resources; enriched its education; forged an inseparable link between the physical and biological sciences; gave to humanity the greatest boon within the gift of man—surgical anesthesia; brought the light of research into the dark corners of existing knowledge; advanced its art and science until it has become an undeniable asset of human welfare.

On the threshold of its second century, dentistry evaluates its past and envisions its future:

To keep sacred the traditions of the profession; to maintain its prestige as an essential health service; to utilize the implements of science in control and cure; to mitigate by prevention dental disease in future generations—these are the tasks of the second century and to their fulfilment American dentistry pledges its energies and devotion.

American Dental Association

February 1, 1940. Arthur A. Merrill, President

The Dental Pledge.

RUBBER MOLDS OF FAMOUS FUNNIES, FAMOUS AMERICANS, NATIONAL TYPES AND ANIMALS

Because of the great number of requests received from dentists for rubber molds of comic strip characters, the Bureau of Public Relations has added some famous funnies, famous Americans, national character types and animals to its stock. The 3¾ inch flat rubber molds of famous funnies show Orphan Annie, Smitty, Dick Tracy, Winnie Winkle, Gasoline Alley, the Gumps, Harold Teen, Terry, Tiny Tim, Little Joe and Moon Mullins; selling for $1.35 per set or 15 cents per mold.

The 3¾ inch flat rubber molds of famous Americans show George Washington, Abraham Lincoln, Theodore Roosevelt, Thomas Jefferson, Benjamin Franklin, U. S. Grant, Daniel Webster and Will Rogers; selling for $1.60 per set or 25 cents per mold.

The 3¾ inch flat rubber molds of national types show an Indian, a Scotchman, a Hawaiian, a Dutch boy and girl, Uncle Sam, John Bull and a Bohemian; selling for $1.40 per set or 25 cents per mold.

Three and three-quarter inch flat rubber molds of animals: bear, chicken, dog, elephant, horse, lion and monkey; $1.75 per set or 30 cents per mold. Order from the Bureau of Public Relations, American Dental Association, 212 E. Superior St., Chicago, Ill.

DENTAL ECONOMICS

NON-PROFIT HOSPITAL SERVICE PLANS*

THE remarkable growth of non-profit hospital service plans as a relatively new method of paying hospital bills makes it difficult to keep abreast with the many changes which have accompanied the growth. From an estimated membership of 2,000 in 1933, the membership had grown to 4,500,000 at the beginning of 1940, when the number of plans had increased to sixty.

Most people are familiar with the benefits provided by hospital service plans, although they may not be familiar with the organization of the plan. As a general rule, a non-profit corporation is first established and trustees are elected, who serve without pay. (Twenty-four states have passed special enabling acts in the past several years to permit the establishment of such non-profit corporations.) The corporation then enters into contracts with employed persons, who agree to pay sums regularly in return for the promise that hospital benefits will be supplied to them when needed. These benefits usually amount to about 21 days' service a year for each person. The subscriber has free choice of member hospitals, and there is no interference with the relationships among hospital, patients and staffs. In most plans, the use of the operating room, anesthetics, dressings, drugs and laboratory work are also covered by the contract.

The corporation also makes contracts with a group of hospitals, which guarantee to provide the necessary hospital facilities in return for the payment of a fixed sum for each day of care provided for subscribers to the plan.

The experience of the first few years in operation of these plans has demonstrated that they must be well organized and efficiently administered in order to operate successfully. The organizers must not be motivated by the desire for pecuniary gain and must be prepared to surmount many difficulties in the path of success. Subscription rates must be high enough to ensure fulfilment of all contractual promises and provide a reasonable reserve for contingencies. In a number of states, rates must be approved by the department of insurance before they can be put into effect.

In order to ensure the utmost chance of success, the plans should have the sponsorship of a variety of community representatives and should not be established unless there is a clear-cut community demand and need. All of the plans have problems of public relations and public education, but their non-profit character makes it less difficult for them to obtain the cooperation and assistance of other community agencies, both public and private. The assistance of these agencies makes it easier to obtain the necessary subscriber enrolment and to gain the approval of employer and employe groups.

The American Hospital Association has promulgated a list of standards for non-profit hospital plans. These standards were established primarily to assure

*Information obtained from a recent publication of the American Hospital Association entitled "Non-Profit Hospital Service Plans," by C. Rufus Rorem. Readers interested in obtaining a brief but complete discussion of this subject should obtain copies of this analysis.

the non-profit character of the enterprise, but they have been extended and revised to include approval of administrative policies and procedures and the financial position of the service. Plans which have the approval of the Commission on Hospital Service are permitted to identify themselves with the American Hospital Association by the use of the latter's insignia superimposed upon a blue cross. Reapproval is granted annually upon evidence of reasonable progress.

SURVEY OF ADULT DENTAL NEEDS

THE Economics Committee of the American Dental Association plans to conduct an extensive nation-wide survey of the dental needs of adults during the week of May 27-31. Present plans are to distribute approximately 40,000 cards to about 8,000 dentists in many states. Each dentist will be asked to record the dental needs of five adult patients who visit his office during the week of the survey and return these records to the Central Office of the American Dental Association.

A preliminary study has indicated that valuable and interesting information can be obtained from such a study. However, the cooperation of a sufficient number of members must be obtained if the survey is to be successful.

Further information concerning this survey will be published in the May issue of THE JOURNAL.

OBITUARIES

RUDOLF KRONFELD, B.S., M.D., D.D.S. (1901-1940)

THE sudden death of Rudolf Kronfeld during the recent Midwinter Meeting of the Chicago Dental Society injected a note of sadness into the meeting, which was felt by all of his friends and acquaintances, particularly in Chicago.

Dr. Kronfeld was born in Vienna, Austria, December 10, 1901. After obtaining his academic education in the Gymnasium, he took up the study of medicine under the direction of his father, who is a dentist, and received his M.D. degree in 1926. Immediately thereafter, he entered the dental school and prepared himself for the practice of dentistry. Soon after his entrance into dentistry, Dr. Kronfeld became attracted to the research aspect of medicine and dentistry and became affiliated in research work with Bernhard Gottlieb, of Vienna, in the Dental Institute.

Rudolf Kronfeld, D.D.S.

In 1929, Dr. Kronfeld came to Chicago to be director of the Department of Research at the Chicago College of Dental Surgery, later becoming professor of dental histology and histopathology of the Chicago College. While pursuing his research work, he qualified for the D.D.S. degree, which he received in 1933.

Dr. Kronfeld's rise in his chosen field was indeed rapid, but was based upon distinguished achievement. He was a brilliant lecturer in and teacher of dental histology, and became the author of two textbooks on the subject, both being recognized as distinctive and authoritative.

He was constantly appearing on the programs of the various dental societies throughout the country, and attained a reputation as a brilliant lecturer through the presentation of his own research work and through his efforts in promoting knowledge in his particular field. He was a man of inexhaustible energy and devoted himself intensively to the promotion of research in the dental educational field.

His death occurred on February 13, 1940. He is survived by his widow, his father and mother and one brother.

JOHN CONNELL GALLAGHER
(1889-1939)

JOHN CONNELL GALLAGHER was born September 25, 1889, in Benson, Minn.; died October 17, 1939, of coronary thrombosis, at his home in Evanston, Ill. His widow, Anne L., and 10-year-old son, John, Jr., survive.

After his graduation from Northwestern University in 1914, he became associated with Austin F. James in the practice of dentistry, chiefly periodontia, in Chicago. He served overseas from 1917 to 1919, being retired with the rank of captain.

Dr. Gallagher was a member of the Chicago Dental Society, Illinois State Dental Society and the American Dental Association and life member of Delta Sigma Delta Fraternity. With his sincere devotion to his profession and his warm generous nature, he had built up a large and successful practice.

DEATHS

BLAIR, EUGENE K., Waverly, Ill.; Missouri Dental College, 1875; died February 2; aged 83.

BROWN, E. S., Edina, Mo.; Western Dental College, 1896; died recently; aged 62.

BUTTRICK, THEODORE R., Detroit, Mich.; Detroit College of Medicine, Department of Dental Surgery, 1899; died February 1; aged 70.

CANADA, HENRY WILKES, Lynchburg, Va.; Baltimore College of Dental Surgery, 1883; died December 15, 1939.

CUNNINGHAM, HARRY E., Mason City, Iowa; State University of Iowa, College of Dentistry, 1915; died January 27; aged 49.

DAVIS, PAUL K., Sterling, Ill.; Northwestern University Dental School, 1922; died January 26; aged 40.

EVANS, CHARLES C., Mobridge, S.D.; Vanderbilt University Dental Department, 1892; died January 8; aged 68.

JORDAN, ESCO E., Kansas City, Kan.; Kansas City Western Dental College, 1916; died January 13; aged 47.

LEWIS, CHARLES B., Ottumwa, Iowa; State University of Iowa College of Dentistry, 1896; died December 31, 1939; aged 63.

MCCARTHY, CHARLES J., San Francisco, Calif.; died January 23.

MCPHAIL, JOHN A., Cincinnati, Ohio; Detroit College of Medicine, Department of Dental Surgery, 1903; died recently; aged 62.

NICK, WALTER E., Erie, Pa.; Western Reserve University, 1910; died January 5; aged 50.

PERRY, JAMES J., Detroit, Mich.; University of Michigan, School of Dentistry, 1900; died January 7.

PETERSON, WILLARD B., Salina, Kan.; Kansas City-Western Dental College, 1927; died December 17, 1939; aged 35.

SMALL, BERTON A., Greeley, Colo.; State University of Iowa, College of Dentistry, 1902; died January 11; aged 62.

TRIPLETT, WILLIAM THOMAS, Salina, Kan.: Keokuk Dental College, 1906; died January 19; aged 63.

CURRENT LITERATURE

Pathogenesis and Radium Therapy of Mixed Tumors of the Salivary Glands

By I. Levin

The author presents a discussion of the pathogenesis and therapy of mixed tumors of the salivary glands, the report being based on a study of twenty-six cases of mixed tumors. About 90 per cent of the tumors occur in the parotid gland. A discussion as to the cellular derivation of the tumors precedes the article, the author favoring the "germinal rest" theory (totipotential cells). The similarity of the mixed tumors of the testis and ovary should be understood, but, unlike them, the salivary gland tumors are slow growing and relatively benign, nonmetastasizing, but show recurrence after removal and may suddenly undergo a malignant change. They should be considered potentially malignant. Differentiation must be made from lymphosarcoma, which is more common in this region. The response to irradiation is greater in lymphosarcoma—a fact which is of diagnostic value. The author prefers a treatment for mixed tumor of the parotid gland consisting of partial excision (so as not to injure the facial nerve) and a radium implant including surface application of radium blocks. Repeated treatment may be necessary.—*Radiology*, 34:69, January 1940.

N. S. Simmons.

Measurements of the Ascending Ramus of the Mandible

By Béla Szokolóczy-Syllaba

Measurements were made on 105 mandibles by means of a modified goniometer, described in the paper. The author found that (1) the deflection of the ramus varied from 2 to 18 degrees, with a median of 10 degrees; (2) the breadth of the ramus from the crista temporalis to the posterior border at the level of the lingula was from 22 to 33 mm., with median values from 24 to 29 mm., and (3) the distance from the inferior border of the mandible to the mandibular foramen varied between 17 and 37 mm., with median values of from 22 to 25 mm.

The author concludes that variations of the mandible are such as to warrant consideration in the administration of local anesthetics and that intra-oral structures alone do not suggest the extreme variations.—*J. D. Res.*, 18:561, December 1939.

B. P. Kearney.

Comparison of the Decalcifying Ability of Different Strains of Oral Lactobacilli

By H. R. Sullivan

Lactobacilli isolated from carious teeth have been classified as either weakly or strongly acidogenic. (*J. D. Res.*, 18:513, December 1939.) Nine strains of each type were tested. Teeth bearing "artificial plaques," made of suspensions of the test organisms in agar, were suspended in glucose broth. The weakly acidogenic organisms produced a dulness over the covered area, but no decalcification. The presence of strongly acidogenic organisms caused definite decalcification of the enamel. Control teeth, whose "plaques" contained no organisms, showed no change.—*J. D. Res.*, 18:525, December 1939.

Hazel Tefft.

Occurrence of Lactobacilli and Other Acidogenic Organisms in the Saliva of Selected Caries-Free Children

By Marshall L. Snyder

The occurrence of lactobacilli and other aciduric organisms (streptococci, staphylococci, sarcinae and yeasts) in the mouths of thirty-eight caries-free children was studied in repeated cultures taken over an eighteen-month period. Cultures were made only on acid tomato-peptone-agar, which is designed to favor the lactobacilli. In one group, eleven of 159 specimens were positive for lactobacilli. In another group, eighty-five of 178 specimens of saliva were positive. The finding of lactobacilli was related to caries,

but, of the other aciduric organisms, only the yeasts showed any relationship.—*J. D. Res.*, 18:497, December 1939.

B. G. Bibby.

Anachoric Effect of Chronic Periapical Inflammations

By Julius Csernyei

The ability of zones of circumscribed inflammation to attract bacteria from the circulation and keep them alive (anachoresis) was investigated in relation to the action of chronic periapical inflammations. Dogs in which periapical inflammation had been established by exposing the pulp were given intravenous injections of *Brucella abortus* (Bangobacillus). When emulsions of the periapical areas were injected into guinea-pigs, typical signs of infection developed and agglutination tests for the organism of the blood were positive. Inoculations of the blood on normal apical tissues from the same dogs gave negative results. It is concluded that chronic periapical inflammation attracts micro-organisms from the blood and that the bacteria remain alive in the inflamed areas. The findings indicate the importance of carrying out root-canal therapy in such a way that periapical inflammation is avoided.—*J. D. Res.*, 18:527, December 1939.

B. G. Bibby.

Acid-Production as a Basis for Classifying Lactobacilli from Carious Teeth

By H. R. Sullivan, J. L. Still and N. E. Goldsworthy

More than 100 strains of lactobacilli isolated from carious teeth have been classified in two groups: weak and strong acid-producers. The two groups were differentiated on three tests: alteration of the appearance of serum-glucose-agar, the change of pH in glucose broth and production of acid in glucose broth daily restored to the original pH. The weakly acidogenic strains changed the appearance of serum-glucose-agar little or not at all, reached a final pH above 5.0 and required less than 8 cc. of N/20 sodium hydroxide to neutralize the acid formed. The strongly acidogenic strains caused an opacity in serum-glucose-agar, reached a final pH below 5.0 and required more than 16 cc. of sodium hydroxide to neutralize the acid formed. The grouping is supported by other biochemical properties, fermentation reactions and an ability to grow on a medium containing sodium taurocholate.—*J. D. Res.*, 18:513, December 1939.

Hazel Tefft.

A Study of the Relative Toxicity of Sodium Fluoride in a Dry Diet in Milk and in Water

By Cecilia Schuck

Sodium fluoride was added to the diet of albino rats in various forms. It was found that sodium fluoride is more toxic in water than in milk and least toxic in a dry diet. A concentration of 0.05 per cent in water resulted in death within two weeks. The same concentration in milk resulted in a marked depression of growth rate. When this concentration was incorporated in a dry diet, only a slight depression in growth rate was evident. Dental fluorosis occurred in all the groups, but appeared earliest in the few surviving rats receiving sodium fluoride in the water.—*J. D. Res.*, 18:491, December 1939.

J. Volker.

Dental Caries: Prevalence Experience at Initial Examinations and Incidence of New Carious Lesions After a One-Year Interval in 1,047 Officers and Enlisted Men of the United States Navy

By Carl A. Schlack

Clinical dental examination of 1,047 naval officers and enlisted men indicates that the prevalence of past and present caries as observed on initial examination is of the order of twenty-four permanent tooth areas per man. This figure was reached by adding the number of permanent tooth areas which contained active carious lesions, filled carious lesions and recurrent caries. Each missing tooth was considered the equivalent of three carious defects.

Reexamination of the 1,047 men one year later reveals that the incidence of new carious defects, after repair of the major proportion of lesions found on first examination, is approximately 1.2 carious areas in the permanent teeth, per man.—*U. S. Nav. M. Bull.*, 38:90, January 1940.

Arthur F. Fisher.

Surgical and Anatomical Aspects of a Case of Double Lower Lip

By Michael L. Mason, Barry J. Anson and Lindsay E. Beaton

A 19-year-old boy had two "congenital pits" on the lower lip, bilaterally placed, but not quite symmetrical. These pits were symptomless, as were those of the patient's father, a paternal uncle and two cousins who had similar bilateral congenital sulci. An excision was made along the long axis of the lip, passing in front of and behind the involuted areas. After removal of the excess tissue, the mucous membrane of the posterior labial surface was brought forward to the anterior edge of the incision. Closure was made with silk without the use of dressings. After repair, the lip had a normal thickness and contour instead of its previous protuberant and bulbous appearance.

Congenital labial lip pits were described by Padgett in 1938 as one of the rarest anomalies of the human body. They are directly hereditary, predominant among females and less common in the upper than the lower lip.—*Surg. Gynec. & Obst.*, 70:12, January 1940.

Arthur F. Fisher.

Malignant Disease of the Face, Mouth, Pharynx and Larynx in the First Three Decades of Life

By Gordon B. New and Charles S. Hertz

Review was made of cases in all patients under 30 years of age, of malignant disease of the face, mouth, pharynx and larynx for the period 1907-1932. The number of cases of malignant disease increased with each succeeding decade. In the first and second decades, the incidence was about the same in both sexes. In the third decade, the incidence was higher in males.

Twelve per cent of the lesions were sarcomata; 88 per cent, carcinomata.

Malignant disease of the tongue, palate, tonsil, pharynx, upper jaw, antrum, lower jaw and larynx, in young persons, is thought to have a poor prognosis. However, according to the data collected here, in seventy-three cases traced, twenty-four patients were living five years after treatment. In thirty-six cases traced, eleven were living ten years after treatment. If cancer of the lip is included, in 111 cases traced, fifty-six patients were living five years after treatment, and in sixty-three traced, thirty-two were living ten years after treatment.

Considering the location of these neoplasms, and the age of the patients, these survival figures are surprisingly high.—*Surg. Gynec. & Obst.*, 70:163, February 1940.

Arthur F. Fisher.

Ludwig's Angina

By Ashbel C. Williams

Ludwig's angina is not a rare condition. It involves infection of the tissues of the submaxillary and sublingual regions and is characterized by a non-fluctuant, brawny edema in these areas. Gross pus may appear later in the disease process. Once a positive diagnosis is made, immediate surgical relief is indicated.

The surgical procedure consists in widely incising the deep cervical fascia and the mylohyoid muscle. Pentothal sodium is recommended as a satisfactory anesthetic. Tracheotomy is often life-saving.

Streptococci alone or with other organisms occur in 72 per cent of cases. Anaerobic organisms are often present. Sulfanilamide is of great value in cases with positive *Streptococcus hemolyticus* cultures. Zinc peroxide is indicated when anaerobic organisms are present. The chief complications are (1) respiratory obstruction, (2) pneumonia, (3) extension of sepsis and septicemia.—*Surg. Gynec. & Obst.*, 70:140, February 1940.

Arthur F. Fisher.

Afferent Impulses from the Teeth Due to Pressure and Noxious Stimulation

By Carl Pfaffmann

Pressure thresholds, measured by means of calibrated bristles and a special lever arrangement, were found to be from 2 to 3 gm. for canine teeth of adult cats and as low as 0.5 gm. for those of young cats. The author feels that most of the sensory endings for pressure sense are located in the peridental membrane, since the response diminished little, if at all, after removal of the pulp.

Impulses obtained by hot and cold stimuli, fracture of a tooth, etc., were found to be of lower voltage and slower conduction rate than those elicited by pressure stimulation.—*J. Physiol.*, 97:207, December 1939.

B. P. Kearney.

Biochemical Studies of the Saliva of Eskimos

By Maxwell Karshan, Eli H. Siegel and Leuman M. Waugh

Total calcium and phosphorus and carbon dioxide capacity were studied in stimulated and unstimulated saliva. The saliva was collected from thirty-one Kuskokwim Eskimos, from 7 to 40 years old, twenty without and eleven with dental caries. Higher mean values for total calcium, inorganic phosphorus and carbon dioxide capacity were found in the caries-free group as compared with the group with caries, and in a group free from calculus as compared with a group with varying amounts of calculus. No correlation was found between the carbon dioxide capacity of saliva and the acid-base balance of the diet.—*Am. J. Dis. Child.*, 59:39, January 1940.

R. F. Sognnaes.

Adenocarcinoma Arising from the Mucous Glands of the Palate with Pulmonary Metastases (Case Report)

By J. G. Sharnoff and J. R. Lisa

The author presents a case of primary adenocarcinoma arising from the mucous glands of the palate with metastases to the cervical lymph nodes and lungs. Clinical and histopathologic description is given of antemortem and postmortem findings. The course of the disease was rapid. A concurrent four plus Wassermann reaction may have been of significance. The author asserts that this is the first reported case of a metastasizing tumor of this character.—*Arch. Otolaryng.*, 31:185, January 1940.

N. S. Simmons.

Dietary and Metabolic Studies of Eskimo Children with and Without Dental Caries

By Eli H. Siegel, Leuman M. Waugh and Maxwell Karshan

In three settlements of the Kuskokwim region of Alaska, balance experiments of from two to four days' duration were performed on twelve caries-free children (8.5-15 years of age) and eleven children with caries (7-15 years of age).

The authors do not draw any definite conclusions, since the experimental period covered only part of a season, but they suggest, from their data, that dental caries need not bear any relationship to calcium-phosphorus and acid-base balances. They disagree with the opinion that primitive people enjoy comparative freedom from dental caries because of a nutritional superiority of "natural" over "civilized" diets.—*Am. J. Dis. Child.*, 59:19, January 1940.

R. F. Sognnaes.

M & B 693 in the Saliva

By B. Fickling, Paul Pincus and B. Boyd-Cooper

To determine the concentrations of the sulfonamide drugs maintained in the mouth, quantitative measurements of M & B 693 in the saliva were made. It was shown that the M & B 693 was present in the saliva and that this was not due to lodgement in the mouth. Repeated dosages of 3 gm. daily gave salivary concentrations as high as 3-6 mg. per 100 cc. Concentrations as high as 20-40 mg. per 100 cc. can be maintained for twelve to twenty-four hours by local applications.—*Lancet*, 2:1310, December 16, 1939.

B. G. Bibby.

Actinomycosis: A New Species, Pathogenic for Man

By George C. H. Franklin

Actinomycosis may be either localized or generalized. It is usually chronic and may persist over a period of months. Probably, the most common etiologic agent is *A. israeli* and the most common site of infection the cervicofacial region. In the case reported, a new species of actinomyces was isolated from a case of actinomycosis of dental origin. The etiologic agent is a saprophyte found in the mouth, pathogenic to man and forming chronic abscesses. Technics for the identification of the organism, tentatively called *Actinomyces moormani*, are described.—*Ann. Int. Med.*, 13:1205, January 1940.

J. Volker.

Ernährung und Zahnkaries Primitiver und Urbaisierter Grönländer (Nutrition and Dental Caries in Primitive and "Civilized" Greenlanders)

By P. O. Pedersen

After an extensive Danish investigation of the dental condition of the Eskimos in

Greenland, the author gives a summary of the data related to diet and dental caries. The information is derived from studies of (1) 525 Eskimo skulls dating back to the precolonization time of Greenland (collection in the University of Copenhagen), (2) 915 Eskimos of unmixed blood now living in East Greenland, where colonization is relatively new, and, finally, (3) 1,634 persons, mostly of mixed blood, living in West Greenland, where there has been, especially during the last thirty years, a considerable influx of "white man's" food.

This study provides an excellent illustration of the increase in the caries frequency which has taken place along with the colonization of Greenland.—*Deutsche Zahn-, Mund- u. Kieferheilk.*, 6:728, December 1939.

R. F. Sognnaes.

Development of Caries in the Teeth of Albino Rats Following Extirpation of the Salivary Glands

By David Weisberger, C. Truman Nelson and Paul E. Boyle

Recently, Cheyne (*J. D. Res.*, 18:457, December 1939) described a technic for the removal of salivary glands from rats. The present authors report that, on total extirpation of the major salivary glands, rats develop a pronounced xerostomia, and, within from fourteen to eighteen days, a severe hypertrophic gingivitis with recession of the gingival tissue about the anterior teeth becomes evident. The effect in the molar teeth is less evident. Associated accumulation of débris about the gingival attachment is found, on microscopic examination, to cause ulceration of the soft tissues and marked resorption of the alveolar bone. Caries develops on the cemental surfaces of the molar teeth, and secondary dentin reaction is present in the pulp. A preliminary report is included on oral flora in such rats in comparison to normal animals. Although there is a significant increase in total quantity with development of the earliest pathologic process, no significant change in the variety of microorganisms is demonstrable. Hormone-agar cultures, however, demonstrate a distinct increase in the quantity of *B. acidophilus* and certain types of staphylococci.

As there is no apparent ill-effect on growth and development of rats on such a non-caries-producing diet as these investigators used, the work seems significant from the standpoint of using the method as a procedure for initiating dental caries in the rat without the previous use of coarse grain diets.—*Am. J. Orthodontics*, 26:88, January 1940.

Virgil D. Cheyne.

Streptococcus Viridans Bacteremia Following Extraction of Teeth

By H. D. Palmer and Myrna Kempf

In a group of eighty-two patients who had not more than two teeth each extracted, 17 per cent developed a transient bacteremia. In 13.4 per cent, the organism was *Streptococcus viridans*. The percentage is roughly parallel to the severity of the infection in the gums and to the extent of the operative procedure. In persons with a normal vascular system and a normal defense mechanism, this form of bacteremia is relatively unimportant, since the circulation is usually cleared of the invaders within a few minutes.

Four case histories and necropsy findings are presented of patients with preexisting rheumatic valvular lesions or congenital defects who died after dental operations.—*J.A.M.A.*, 113:1788, November 11, 1939.

B. P. Kearney.

The Submicroscopic Structure of Dental Enamel

By J. Thewlis

The submicroscopic structure of human deciduous enamel has been studied by means of x-ray diffraction and photomicrographic methods. It has been found that each enamel prism is composed of a multitude of crystallites of apatite, which may be divided into two groups, according to the angles which their hexagonal axes make with the direction of the prisms. These angles are 5 and 40 degrees, respectively, the first group being predominant. Variations in the crystalline orientation or in prism regularity have been recorded by x-ray photomicrographs, and the microstructure has been graded into three classes according to quality. The interprismatic substance, like the prism material, usually contains both of the groups of apatite crystallites, but as regards the degree of its quality, nothing could be stated.—*D. Rec.*, 60:49, February 1940.

R. F. Sognnaes.

INCIDENTS OF PRACTICE

Supernumerary Tooth

By MARTIN T. SIEGEL, D.D.S., Poughkeepsie, N. Y.

A GIRL aged 14 came in for a routine examination. Clinical and roentgen-ray examinations revealed (1) a supernumerary maxillary left second incisor, in normal occlusion and perfect in appearance, as shown in the accompanying illustration, and (2) in the right maxilla, an impacted second bicuspid. More logically, the impacted tooth would have been on the same side as the supernumerary tooth.

Supernumerary maxillary incisor and impacted second bicuspid.

39 Market Street.

Tooth Brushing Technics

By STANLEY M. GOWER, D.M.D., Skowhegan, Maine.

IF we can judge from the flood of advertising appearing in the dental journals in recent months concerning the importance of "massage brushing," it would appear that a new method for home care of the teeth has been developed which will readily restore and maintain healthful mouth conditions.

If I understand the term "massage brushing" as it is now being used, it refers to a technic advocated by certain prominent periodontists, whereby the emphasis in mouth hygiene is laid on the importance of so applying the toothbrush head as to bring alternate pressure and release on the septa of the gums in the interproximal areas, and relying on a sort of "shimmying" impulse given the handle for this effect. The patient is cautioned not to apply sufficient motion to the handle to dislodge the bristles from the area where they are first placed. Apparently, emphasis is now being placed on the necessity for healthy gums rather than for clean teeth. Obviously, both are of the highest importance.

It is interesting to note that the advocates of the "massage brushing" technic point out that it is not suitable for group instruction to children in the public schools, and furthermore that the average adult requires from four to six appointments before he can hope to acquire the skill necessary to safely and effectively carry out the highly specialized technic involved.

Who, then, would not be glad if there might not be found a scientifically sound technic which is adaptable to both children and adults, and which experience proves conclusively will assure firm, healthy gums and clean, highly polished teeth, and, if used at all intelligently,

need not result in either gum recession or "wasting" of the enamel?

This seemingly ideal method has been found, and the results obtained over a long period are so conclusive and satisfactory as to make those familiar with it indifferent to the other systems advocated, however valuable they may be under special conditions with very limited numbers. I refer to the so-called large circular method, made famous by the outstanding results obtained by it in the Bridgeport, Conn., area by the late Alfred C. Fones, originator of the dental hygienist movement, and under whose efficient instruction the first class of hygienists were graduated twenty-five years ago.

The value of this technic depends on several conditions: a light rapid application of the full surface of a brush equipped with stiff bristles of medium size, in circular movements large enough to cover both the gums and teeth in a given area. The rapid, light stroke increases the circulation in the gums without irritation, as well as resulting in a high polish of the tooth surfaces. The large circular motion gets away from the evils of the horizontal stroke so generally practiced. Emphasis must be placed, however, on the necessity of a light stroke, because, with this method, the gums become so hard and healthy that the patient can apply a very considerable force without being aware of it. This will result in gum recession, particularly in the cuspid region. Otherwise, it is as nearly "fool proof" as any system yet devised, and can be readily practiced by both children and adults after comparatively little instruction.

Traumatic Trismus: Report of a Case

By Virgil Marinelli, D.D.S., Mt. Vernon, N. Y.

History.—A man aged 26 complained of toothache in the lower right molar region. He had some difficulty in speaking owing to the fact that he was unable to open his mouth. The mandible was retruded a great deal.

As a young boy, the patient had been kicked by a horse, severe injury of the face resulting. A few years later, he noted that he could not open his mouth fully. This difficulty gradually increased until he could open his mouth only about one-quarter inch. Three years ago, he was operated on for ankylosis of the mandibular joints. The condyle and coronoid processes of the left and the coronoid process of the right mandible had been resected. Immediately after the operation, the patient was able to move and open the jaw normally. During the past seven months, the trismus had recurred and he again was unable to open his mouth.

Examination.—On examination, it was found that the mandible could be opened only one-quarter inch. A carious lower right first molar and second bicuspid were the source of the pain. This diagnosis was confirmed by an extra-oral roentgenogram. The general oral and the dental condition were poor.

Operation.—Preoperative medication of one-quarter grain of morphine sulfate was given hypodermically. An attempt was made to open the mouth in order to administer a mandibular block anesthesia, but it could be opened only one-half inch, which was not sufficient to allow use of the ordinary syringe employed for dental anesthesia. Therefore, a very long and narrow syringe was used, and with this the mandibular foramen was reached and block anesthesia induced.

A buccal flap was made, extending from the lower second molar area to the cuspid area. The buccal plate was removed. Then, with a surgical bur, the crowns of the lower right first molar and second bicuspid were cut off. The roots of the first molar were split and removed with an elevator, as was the root of the bicuspid. The surrounding bony tissues were trimmed with a rongeur and filed. The flap was sutured in place and an iodoform drain was inserted in the sockets.

Postoperative Care.—The postoperative care consisted of application of ice packs to the face and intra-oral, hot saline irrigations every two hours. The drain was changed every twenty-four hours. The sutures were

removed after four days and the drain was discontinued.

Outcome.—There was little postoperative reaction, with only a slight swelling. The area healed rapidly and recovery was uneventful.

The patient is to return shortly to the Columbia Oral Surgery Department, where he will undergo resection of the right condyle.

110 East Sidney Avenue.

Internal Resorption: Report of a Case

By J. C. Eselman, D.D.S., Pittsburgh, Pa.

History.—M. C., a man, aged 29, complained of severe pain on the left side of the face. The pain increased when hot foods or drinks were taken and was relieved by cold. The teeth in this area were normal in appearance, with no gross evidence of caries.

Roentgenographic Examination.—There was a radiolucent area around the upper left second molar, starting at the bifurcation of the roots and extending toward the apices, with a marked resorption of the alveolar process between the upper left first and second molars. There was no history of extraction of a third molar.

Diagnosis.—The diagnosis was venous hyperemia of the pulp due to internal resorption.

Operative Procedure.—The tooth was extracted under conduction anesthesia.

From the Department of Radiography, University of Pittsburgh.

Burning Tongue

By A. L. Borish, D.D.S., Philadelphia, Pa.

History.—K., a man, aged 60, complained of burning tongue, of which he had been particularly conscious for three years. He had consulted many leading physicians and had undergone numerous tests. The condition was attributed to various conditions from time to time: smoking, faulty diet, faulty use of the toothbrush, excessive use of mouthwash, but correction or elimination of these supposed causes gave no relief. The patient was convinced that he had cancer and could not be swerved from his opinion.

Examination.—X-ray examination of the teeth proved negative. But one tooth, the upper right second bicuspid, was missing. Clinically, interest centered in the six lower anterior teeth, which were very irregularly positioned and in various stages of version and separation. (Fig. 1.)

Treatment.—A removable all-gold cast appliance (Fig. 2) was designed to close the gaps between the teeth and give the tongue a smooth area to oppose instead of the possibly irritating irregularities presented by the lower anterior teeth.

Fig. 1.—Condition of lower anterior teeth.

Fig. 2.—Removable appliance.

Outcome.—The patient experienced relief slowly, but steadily enough to encourage his constant use of the appliance. After a few months, relief was complete, with only casual return of a slight burning sensation. Three years after insertion of the appliance, the patient is convinced that the cause was local, and he has been relieved of his cancer phobia.

5944 Lansdowne Avenue.

Five State Post Graduate Clinic

WASHINGTON, D. C.
MAY 19-23

THE District of Columbia Dental Society extends a cordial welcome to all members of the American Dental Association to attend the Eighth Annual Five State Post Graduate Clinic at the Willard Hotel, Washington, D. C.

This meeting has grown to be one of the finest in the east. Each year, it has had an increasingly large attendance. It presents an excellent array of scientific clinics as well as a most interesting social program. The dates of the meeting were changed from the usual time in March to May this year to avoid conflict with the Dental Centenary in Baltimore.

May is one of the most beautiful months of the year in the Nation's Capitol, and this should help to insure a large attendance.

Following is a partial program of the meeting:

R. E. MORGAN, M.D.: Plastic Surgery Involving the Oral Tissues.
ROY J. GLEZEN, D.D.S.: Immediate Fixed Bridgework.
W. W. HURST, D.D.S.: Immediate Complete Denture Service.
LOUIS S. BLOCK, D.D.S.: Study and Treatment of Temporomandibular Joint Problems.
LEROY M. ENNIS, D.D.S.: The Practical Phase of Roentgenology.
CARLISLE C. BASTIAN, D.D.S.: Ceramics in Dentistry.
JAMES P. STANTON, D.D.S.: Rebasing Complete Dentures.
HAROLD GOLDSTEIN, D.D.S.: Diagnosis and Treatment Planning in Periodontal Disease and Diseases of the Oral Mucous Membranes.
J. L. B. MURRAY, D.D.S.: Dental Education.
R. E. RAMAKER, D.D.S.: Correction of Arch Deformities in the Infant.
MERRILL G. SWENSON, D.D.S.: Complete Dentures.
JAMES R. CAMERON, D.D.S.: Oral Surgery.
S. W. BROWN, D.D.S.: Condensing Procedures in Amalgam Restorations.
E. HOWELL SMITH, D.D.S.: Clinical Photography.

D. J. FITZGIBBON, *Chairman,*
Publicity Committee,
1801 Eye St., N. W.,
Washington, D. C.

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

AMERICAN ACADEMY OF PERIODONTOLOGY, Cleveland, Ohio, September 5-7.

AMERICAN ASSOCIATION OF ORTHODONTISTS, Chicago, Ill., May 13-16.

AMERICAN BOARD OF ORTHODONTICS, Chicago, Ill., May 11.

AMERICAN COLLEGE OF DENTISTS, Baltimore, Md., March 17.

AMERICAN DENTAL ASSISTANTS ASSOCIATION, Cleveland, Ohio, September 9-12.

AMERICAN DENTAL ASSOCIATION, Cleveland, Ohio, September 9-13.

AMERICAN PUBLIC HEALTH ASSOCIATION, Detroit, Mich., October 8-11.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS, Cleveland, Ohio, September 6-7.

CANADIAN AND ONTARIO DENTAL ASSOCIATIONS, Toronto, May 27-29.

CLEVELAND DENTAL SOCIETY, April 8-9.

DISTRICT OF COLUMBIA DENTAL SOCIETY, second and fourth Tuesdays in each month from October to June at the United States Public Health Service Auditorium, Washington.

FIVE STATE POST GRADUATE CLINIC, Washington, D. C., May 19-23.

NATIONAL BOARD OF DENTAL EXAMINERS, May 6-7.

NATIONAL DENTAL ASSOCIATION, St. Louis, Mo., August 12-16.

NORTH ATLANTIC ORTHODONTIC SOCIETY, New York, N. Y., May 1.

OHIO STATE UNIVERSITY ALUMNI, Columbus, April 17-18.

DENTAL ALUMNI SOCIETY, University of Pennsylvania, Philadelphia, September 19.

ALUMNI SOCIETY OF THE PHILADELPHIA DENTAL COLLEGE, Philadelphia, May 22-23.

WASHINGTON UNIVERSITY DENTAL ALUMNI ASSOCIATION, St. Louis, Mo., April 10.

WISCONSIN STATE DENTAL ECONOMIC STUDY CLUB, Madison, August 2-3.

STATE SOCIETIES

April

Alabama, at Birmingham (9-11)
Arizona, at Tucson
Kansas, at Kansas City, Mo. (28-May 1)
Kentucky, at Owensboro (11-13)
Louisiana, at Monroe (18-20)
Massachusetts, at Boston (22-25)
Michigan, at Detroit (15-17)
Mississippi, at Jackson (15-17)
Missouri, at Kansas City (28-May 1)
North Dakota, at Bismarck (21-24)
Oklahoma, at Tulsa (14-16)
Texas, at Dallas (9-11)
Wisconsin (22-25)

May

Arkansas, at Little Rock (20-22)
California State, at Oakland (13-15)
District of Columbia, at Washington (19-23)
Georgia, at Macon (14-16)
Illinois, at Springfield (13-16)
Indiana, at Indianapolis (20-22)
Iowa, at Des Moines (6-8)
Montana, at Billings (2-4)
Nebraska, at Lincoln (20-23)
New Jersey, at Asbury Park (8-10)
New York, at Buffalo (14-17)
North Carolina, at Charlotte (6-8)
South Carolina, at Spartanburg (20-21)
South Dakota, at Sioux Falls (12-14)
Tennessee, at Memphis (13-16)
Vermont, at Burlington (15-16)
Virginia, at Lynchburg (13-15)
West Virginia, at Charleston (20-22)

June

Colorado, at Colorado Springs (20-22)
Connecticut, at New London (5-7)
Idaho, at Sun Valley (24-26)
Maine, at Lakewood (23-25)
Nevada, at Reno (8)
New Hampshire, at North Conway
New Mexico, at Santa Fe

Oregon, at Portland (12-15)
Pennsylvania, S. S. South American (13-16)
Utah, at Salt Lake City
Wyoming, at Rock Springs

August

Hawaii, at Honolulu

October

Southern California, at Los Angeles

November

Ohio, at Cincinnati

STATE BOARDS OF DENTAL EXAMINERS

Alabama, at Birmingham, June 24. W. A. Wood, 1004 Merchants National Bank Bldg., Mobile, Secretary.

Arkansas, at Little Rock, June 17-20. Clarence W. Koch, 817 Donaghey Bldg., Little Rock, Secretary.

California, at San Francisco, June 3, and at Los Angeles, June 24. Kenneth I. Nesbitt, 515 Van Ness Ave., San Francisco, Secretary.

Connecticut, at Hartford, June 25-29. Almond J. Cutting, Southington, Recorder.

Delaware, at Wilmington, June 5-7. Charles R. Jefferis, Medical Arts Bldg., Wilmington, Secretary.

Florida, at Jacksonville, June 24. H. B. Pattishall, 351 St. James Bldg., Secretary.

Indiana, at Indianapolis, June 4-7. J. M. Hale, Mt. Vernon, Secretary.

Kentucky, at Louisville, June 11-14. Leon M. Childers, 1312 First National Bank Bldg., Lexington, Secretary.

Mississippi, at Jackson, June 18. A. B. Kelly, Yazoo, Secretary.

Montana, at Helena, July 8. Leonard A. Jenkin, 401 Ford Bldg., Great Falls, Secretary.

New Jersey, June 24-29. Walter A. Wilson, 148 W. State St., Trenton, Secretary.

North Carolina, at Raleigh, June 24. Wilbert Jackson, Rich Building, Secretary.

North Dakota, at Fargo, July 8-11. L. I. Gilbert, 401 Black Bldg., Fargo, Secretary.

Ohio, at Columbus, June 24-28. Morton H. Jones, 1553½ North Fourth St., Columbus, Secretary.

Oklahoma, at Oklahoma City, June 17-20. W. T. Longwell, Frederick, Secretary.

Pennsylvania, at Pittsburgh and Philadelphia, June 18-22. Reuben E. V. Miller, 61 North Third St., Easton, Secretary.

Rhode Island, at Providence, June 25-27. Philip J. Conley, 2 Old Colony Bldg., West Warwick, Secretary.

South Carolina, June 17-19. T. C. Sparks, Columbia, Secretary.

South Dakota, at Sioux Falls, January 24-27, 1941. C. H. Boyden, Mitchell, Secretary.

Texas, at Houston, June 17-21. B. Carl Holder, 1009 Nixon Bldg., Corpus Christi, Secretary.

Vermont, at Montpelier, June 24-26. C. I. Taggart, 139 Bank St., Burlington, Secretary.

Wisconsin, at Milwaukee, June 17-21. S. F. Donovan, Tomas, Secretary.

MISSISSIPPI DENTAL ASSOCIATION

THE next meeting of the Mississippi Dental Association will be held at Jackson at the Robert E. Lee Hotel, April 15-17.

GEORGE P. EVANS, *Secretary.*
Jackson.

MISSOURI-KANSAS DENTAL MEETING

THE Missouri-Kansas Dental Meeting will be held in the Municipal Auditorium, Kansas City, Mo., April 28-May 1.

ROY L. FELKNER, *Chairman of Publicity,*
Shukert Bldg.,
Kansas City, Mo.

NORTH DAKOTA STATE DENTAL ASSOCIATION

(Change of Dates)

THE annual meeting of the North Dakota State Dental Association will be held at Bismarck, April 21-24.

BOARD OF DENTAL EXAMINERS OF ALABAMA

THE Board of Dental Examiners of Alabama will conduct its next annual dental examination in Birmingham beginning at 8:30 a.m., June 24. All credentials must be filed with the secretary at least two weeks in advance of the examination. Address all correspondence to W. A. Wood, Secretary, 1004 Merchants Nat'l Bank Bldg., Mobile.

CONNECTICUT DENTAL COMMISSION

THE Connecticut Dental Commission will meet in Hartford June 25-29 for the examination of applicants for license to practice dentistry or dental hygiene and to

transact any other business proper to come before it. Applications should be in the hands of the recorder at least ten days before the meeting. For application blanks and further information, apply to

ALMOND J. CUTTING, *Recorder,*
Southington.

DELAWARE STATE BOARD OF DENTAL EXAMINERS

THE Delaware State Board of Dental Examiners will hold examinations June 5-7 at Wilmington.

CHARLES R. JEFFERIS, *Secretary,*
Medical Arts Building,
Wilmington.

FLORIDA STATE BOARD OF DENTAL EXAMINERS

THE annual examination for license to practice dentistry and license to practice dental hygiene in Florida will be held in Jacksonville, commencing June 24, at the Seminole Hotel. Preliminary applications must be filed sixty days prior to date of examination. Address all communications to

H. B. PATTISHALL, *Secretary,*
351 St. James Bldg.,
Jacksonville.

INDIANA STATE BOARD OF DENTAL EXAMINERS

THE next examination for licensure of the Indiana State Board of Dental Examiners will be held in Indianapolis beginning Tuesday, June 4 and continuing for four days. All applications, fees and credentials must be in the hands of the secretary not later than ten days prior to the beginning date of the examination. For applications, instructions to candidates and other information, address

J. M. HALE, *Secretary,*
Mt. Vernon.

MISSISSIPPI STATE BOARD OF DENTAL EXAMINERS

THE Mississippi State Board of Dental Examiners will hold its next examination of applicants for license to practice dentistry and to practice dental hygiene in Jackson, beginning June 18. Examinations will be both theoretical and practical. Fee for dental applicants, $25; for dental hygienists, $15. Applications and fees must be in the hands of the secretary on or before June 8. Address all communications to

A. B. KELLY, *Secretary,*
Yazoo City.

MONTANA STATE BOARD OF DENTAL EXAMINERS

THE next annual meeting of the Montana State Board of Dental Examiners for the examination of applicants to practice dentistry or dental hygiene will be held at Helena beginning July 8. Applications must be filed with the secretary at least twenty days prior to the examination. For application blanks and further information, address

LEONARD A. JENKINS, *Secretary,*
401 Ford Bldg.,
Great Falls.

DENTAL COUNCIL AND EXAMINING BOARD OF THE COMMONWEALTH OF PENNSYLVANIA

THE Dental Council and Examining Board of the Commonwealth of Pennsylvania will conduct examinations in Philadelphia and Pittsburgh, June 18-22. For information and applicant blanks, address the Department of Public Instruction, Bureau of Professional Licensing, Dental Division, Harrisburg, or

REUBEN E. V. MILLER, *Secretary,*
61 North Third St.,
Easton.

RHODE ISLAND STATE BOARD OF EXAMINERS IN DENTISTRY

THE next examination to be conducted by the Board of Examiners in Dentistry for dentists and dental hygienists will be held in Room 365, State Office Building, Providence, June 25-27. All credentials must be on file at least thirty days prior to the date of the examination. For information and application blanks, address the Department of Health, Division of Examiners, State Office Building, Providence, or

PHILIP J. CONLEY, *Secretary,*
2 Old Colony Bldg.
West Warwick.

SOUTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

THE South Carolina State Board of Dental Examiners will hold its next examination June 17-19.

T. C. SPARKS, *Secretary,*
1508 Washington St.,
Columbia.

VERMONT STATE BOARD OF DENTAL EXAMINERS

THE Vermont State Board of Dental Examiners will meet June 24-26 in the State House, Montpelier, to examine applicants for license to practice dentistry and dental hygiene. All applications, together with examination fee, must be in the hands of the secretary at least fifteen days before the date of the meeting. Address all communications to

C. I. TAGGART, *Secretary,*
139 Bank St.,
Burlington.

NATIONAL BOARD OF DENTAL EXAMINERS

THE National Board of Dental Examiners will hold its next session for the examination of candidates in Part I and Part II, May 6-7, in schools where there are five or more candidates. For information and applications, address

MORTON J. LOEB, *Secretary,*
66 Trumbull St.,
New Haven.

AMERICAN ACADEMY OF PERIODONTOLOGY

THE American Academy of Periodontology will hold its twenty-seventh annual meeting September 5-7 at the Hotel Cleveland, Cleveland, Ohio.

RAYMOND E. JOHNSON, *Secretary,*
824 Lowry Bldg.,
St. Paul, Minn.

CLEVELAND DENTAL SOCIETY

THE Annual Spring Clinic Meeting of the Cleveland Dental Society will be held April 8-9 at the Statler Hotel.

IRWIN F. STEUER, *Chairman,*
Publicity Committee,
562 Rose Bldg.,
Cleveland, Ohio.

THE NORTH ATLANTIC ORTHODONTIC SOCIETY

THE twelfth semi-annual meeting of the North Atlantic Orthodontic Society will be held May 1 at the Hotel Pennsylvania, New York, N. Y. All ethical members of the dental and medical professions are invited.

WALTER H. JACOBS, *Secretary,*
124 W. 93d St.,
New York, N. Y.

EXAMINATION FOR APPOINTMENT IN THE DENTAL CORPS OF THE NAVY

A COMPETITIVE examination to select not more than twenty for appointment in the Dental Corps of the Navy will be held July 8 at the Naval Medical School, Washington, D. C.; Naval Training Station, Great Lakes, Ill., and Naval Training Station, San Diego, Calif. A candidate for appointment in the Dental Corps must be a citizen of the United States, between 21 and 32 years of age at the time of appointment and a graduate of a standard dental college. A circular which contains full information relative to the Dental Corps and describes the method of making application for appointment can be obtained from the Bureau of Medicine and Surgery, Navy Department, Washington, D. C.

DENTAL INTERNSHIP

APPLICATIONS are now in order for appointment to a twelve-month internship, beginning July 1, at St. Luke's Hospital, Morningside Heights, New York, N. Y. The dental intern will be instructed in a wide variety of dental activities. Applications should be made as soon as possible, stating qualifications. In applying, address

JEROME M. SCHWEITZER, D.D.S.,
Chief of Dental Department.

POSTGRADUATE COURSES AT THE UNIVERSITY OF PENNSYLVANIA

THE School of Dentistry of the University of Pennsylvania offers the following special postgraduate courses:

1. Ten-day course in oral surgery, roentgenology, exodontia and local and general anesthesia, consisting in part of lectures on the subjects, supplemented by lectures and demonstrations in anatomy, bacteriology and pathology, as they pertain to the clinical subjects. Most of the time will be spent in clinical instruction at the Evans Institute and at various hospitals.

Time: Monday, May 20, to Thursday, May 30. Fee: $75, $25 to be sent with application and $50 payable at the time of registration at the school.

2. Four-day general refresher course, including nearly all clinical subjects in the curriculum. Subjects will be arranged so as to permit considerable latitude in selection

of subjects to be taken. Complete details will be announced later.

Time: Monday, June 3, to Thursday, June 6. Fee: $10, payable in advance. Applicants for either of these courses should state their school and class and dental society affiliation. They are not restricted necessarily to University of Pennsylvania graduates, but alumni will be given preference in case the numerical limits are exceeded. Application should be made to the Dean, School of Dentistry, University of Pennsylvania, Evans Institute, 40th and Spruce Sts., Philadelphia, Pa.

DENTAL ALUMNI SOCIETY, UNIVERSITY OF PENNSYLVANIA

COMPLYING with the request of the Bicentennial Planning Committee, the Executive Committee of the Dental Alumni Society of the University of Pennsylvania has decided to hold its annual meeting September 19. The society will meet in the Evans Institute at 11 a.m. Luncheon will be served at noon and dinner at 6:30 p.m. Complete details will be published later.

Z. T. JACKAWAY, *Secretary,*
1506 E. Susquehanna Ave., Philadelphia.

AMERICAN BOARD OF ORTHODONTICS

A MEETING of the American Board of Orthodontics will be held at the Edgewater Beach Hotel, Chicago, May 11. Orthodontists who desire to qualify for certificates from the board should secure the necessary application blanks from the secretary. The applications must be returned to the secretary, together with any other required credentials, prior to the date of examination. Applications filed at the time of the board meeting will have preliminary consideration, so that the applicant may be advised of the work required for his subsequent examination. Attention is called to the following resolutions adopted by the board: Any person desiring to make application to the board for a certificate must have been in the exclusive practice of orthodontics for a period of not less than five years or an equivalent to be determined by the board and based upon the following conditions: 1. He must be an instructor in orthodontics in a school satisfactory to the board. 2. He must be the associate in the office of an orthodontist whose standing is satisfactory to the board. 3. It is to be definitely understood that any person at the time of making application for a certificate shall be in the exclusive practice of orthodontics in his own name. For further information, address

CHARLES R. BAKER, *Secretary,*
636 Church St., Evanston, Ill.

OHIO STATE UNIVERSITY ALUMNI MEETING

THE large attendance and enthusiasm evidenced at last year's Ohio State University Dental College Alumni meeting have resulted in plans for another two-day educational and scientific program for April 17-18. All Ohio dentists are invited. Invitations, reservation cards and programs will be mailed to all O. S. U. alumni. Graduates of other schools wishing to receive these programs, etc., will be supplied on addressing the Dental College, Ohio State University.

ALUMNI SOCIETY OF THE PHILADELPHIA DENTAL COLLEGE

Seventy-Seventh Annual Session

Wednesday, May 22

9:00 a.m. Registration.

9:30 a.m. President's Address, Raymond C. Walter. Business Session. Dean's Report, I. N. Broomell.

10:00 a.m. Oral Surgery Section, James C. Cameron, presiding. Speaker: Theodore Blum, M.D., D.D.S., F.A.C.D., F.A.C.S. Subject: Mouth Lesions, Their Diagnosis and Subsequent Treatment. Discussors: O. E. Reidel, '16, York, Pa.; Naysh Brennan, '18, Shenandoah, Pa.

12:00 noon. Luncheon.

1:30 p.m. Unveiling ceremony. Dedication of plaques to the memory of Addinell Hewson and Levi Pownall.

2.00-4:30 p.m. Table clinics.

7:00 p.m. Annual reunion banquet, Penn. A. C., Rittenhouse Square. Smedley D. Butler, Speaker.

Thursday, May 23, 1940

10:00 a.m. Greetings, Raymond Walter, president. Second annual forum, Frederic James, presiding. Topic: Periodontia, J. Lewis Blass, Ph.G., D.D.S., associate professor of periodontia, New York University, N. Y.; Medicine, John A. Kolmer, M.S., Dr.P.H., D.Sc., LL.D., L.H.DL., F.A.C.P., professor of medicine, in charge of bacteriology and immunology, Temple Univer-

sity School of Medicine; Roentgenology, W. Edward Chamberlain, B.A., M.D., professor of radiology and roentgenology, Temple University School of Medicine.

12:00 noon. Luncheon.

1:30 p.m. Prosthesis Section, R. C. Walter, presiding. Speaker: David G. Bell. Subject: Full Denture Prosthesis. Illustrated lecture and practical demonstration.

2:30-4:30 p.m. Table clinics.

REFRESHER COURSE IN DENTAL ROENTGENOLOGY
School of Dental and Oral Surgery, Columbia University

THE School of Dental and Oral Surgery, Columbia University, offers an intensive theoretical and practical course in dental roentgenology, July 15-19. This course will consist of lectures and demonstrations, and each member of the class will have practice in carrying out the technical procedures. The course will be of particular value to those engaged in the interpretation of normal and pathologic conditions of the oral cavity as a specialty, or in hospital clinics or teaching institutions. The technic is radically different from the usual textbook method of bisecting the angle.

Admission to the course is limited to members in good standing of the American Dental Association or recognized sectional organizations. In the case of foreign applicants, membership in the applicant's national dental organization is required.

Applications accompanied by $25 reservation deposit should be sent to the Registrar, School of Dental and Oral Surgery, 630 West 168th Street, New York, N. Y., before June 1.

CANADIAN AND ONTARIO DENTAL ASSOCIATIONS

THE annual convention of the Ontario Dental Association and the Canadian Dental Association will be held at the Royal York Hotel, Toronto, May 27-29. Dentists from the United States and from all parts of Canada will be welcome.

FRED J. CONBOY, *Secretary*,
86 Bloor St. West, Toronto.

UNITED STATES PATENTS APPLICABLE OR PERTAINING TO DENTISTRY ISSUED DURING JANUARY 1940

January 2

No. 2,185,229, to WADE E. SCOTT. Rotary toothbrush.

No. 2,185,508, to ALBERT J. KUNZE. Apparatus for making dental records.

No. 2,185,867, to IRVING PENSKY. Toothbrush head.

January 9

No. 2,186,005, to GLENN L. CASTO. Toothbrush.

No. 2,186,468, to JACOB R. SCHWARTZ. Method of producing tooth forms.

No. 2,186,520, to SIDNEY DAIL BURKINSHAW. Toothbrush.

No. 2,186,600, to WALTER S. BEHRENS. Sterilizer for dental handpieces.

January 16

No. 2,187,076, to PRENTIS E. ERICKSON. Vibrating toilet apparatus.

No. 2,187,077, to PRENTIS E. ERICKSON. Toothbrush supporting device for tooth massaging apparatus.

No. 2,187,259, to GEORGE E. BARNHART. Hypodermic needle.

No. 2,187,260, to OSCAR R. BRANDENBURG. Matrix.

No. 2,187,442, to JOHN B. BEACH. Dental floss holder.

No. 2,187,457, to CHARLES D. KREPS. Dental partial plate holder.

No. 2,187,560, to THOMAS J. REILLY. Massage implement.

No. 2,187,586, to WILLIAM J. HOOPER. Dental spray.

No. 2,187,597, to JAMES G. BLASO. Anesthetic.

No. 2,187,598, to JAMES G. BLASO. Self-spraying anesthetic preparation.

January 23

No. 2,187,747, to JOHN A. LINDE. Orthodontic adjusting tool.

No. 2,187,899, to ISABELLE HENNE. Dental floss throw-away unit.

No. 2,188,217, to WILLIAM E. BEHRING. Toothbrush.

January 30

No. 2,188,415, to OTTO C. MALSCH. Dental flask.

No. 2,188,426, to JAMES H. BLAIR. Dental handpiece.

No. 2,188,449, to WILLIAM C. STEWART. Cleaning and massaging device.